PATENT COOPERATION TREAT

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 28 August 2000 (28.08.00)	
International application No. PCT/US99/26126	**Applicant's or agent's file reference** 32283-PCT
International filing date (day/month/year) 05 November 1999 (05.11.99)	**Priority date** (day/month/year) 06 November 1998 (06.11.98)
Applicant PAEK, Seungyup et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

05 June 2000 (05.06.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Manu Berrod

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:

HENRY TANG
BAKER & BOTTS, LLP
30 ROCKEFELLER PLAZA
NEW YORK NY 10112-0228

PCT

NOTIFICATION OF THE INTERNATIONAL APPLICATION NUMBER AND OF THE INTERNATIONAL FILING DATE

(PCT Rule 20.5(c))

Date of mailing (*day/month/year*)	07 DEC 1999
Applicant's or agent's file reference: 32283-PCT	IMPORTANT NOTIFICATION

International application No.	International filing date (*day/month/year*)	Priority date (*day/month/year*)
PCT/US99/26126	05 NOV 99	06 NOV 98

Applicant: THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

Title of the invention: VIDEO DESCRIPTION SYSTEM AND METHOD

1. The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above.

2. The applicant is further notified that the record copy of the international application:

☒ was transmitted to the International Bureau on 07 DEC 1999.

☐ has not yet been transmitted to the International Bureau for the reason indicated below and a copy of this notification has been sent to the International Bureau*:

☐ because the necessary national security clearance has not yet been obtained.

☐ because (*reason to be specified*):

* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22.1(c)).

3. FOREIGN TRANSMITTAL LICENSE INFORMATION Completed by: DHA

☐ Additional license for foreign transmittal not required. This subject matter is covered by a license already granted on the equivalent U.S. national application. Refer to that license for information concerning its scope.

☐ License for foreign transmittal not required. 37 CFR 5.11(e)(1) or 37 CFR 5.11(e)(2). However, a license may be required for additional subject matter. See 37 CFR 5.15(b).

☑ Foreign transmittal license granted. 35 U.S.C. 184; 37 CFR 5.11 on 11-19-99 (date):

☑ 37 CFR 5.15(a) ☐ 37 CFR 5.15(b)

Name and mailing address of the receiving Office Assistant Commissioner for Patents Box PCT Washington, D.C. 20231 Attn: RO/US Facsimile No.	Authorized officer Vanessa Clark PCT Opertions - IAPD Team 1 (703) 305-6485 (703) 305-3230 (FAX) Telephone No.

Form PCT/RO/105 (July 1992)

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14

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 32283-PCT	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/US99/26126	International filing date *(day/month/year)* 05 NOVEMBER 1999	Priority date *(day/month/year)* 06 NOVEMBER 1998
International Patent Classification (IPC) or national classification and IPC Please See Supplemental Sheet.		
Applicant THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 0 sheets.

3. This report contains indications relating to the following items:

   I ☒ Basis of the report

   II ☐ Priority

   III ☐ Non-establishment of report with regard to novelty, inventive step or industrial applicability

   IV ☐ Lack of unity of invention

   V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

   VI ☐ Certain documents cited

   VII ☐ Certain defects in the international application

   VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
05 JUNE 2000	14 MARCH 2001
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer ELLA COLBERT James R. Matthews Telephone No. (703) 308-7064

Form PCT/IPEA/409 (cover sheet) (July 1998)★

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US99/26126

I. Basis of the report

1. With regard to the elements of the international application:*

[X] the international application as originally filed

[X] the description:
pages 1-46 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the claims:
pages 47-61 , as originally filed
pages NONE , as amended (together with any statement) under Article 19
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the drawings:
pages 1-16 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the sequence listing part of the description: NONE , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

[ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

[ ] the language of publication of the international application (under Rule 48.3(b)).

[ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international

[ ] contained in the international application in printed form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readable form.

[ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] The statement that the information recorded in computer readable form is identical to the writen sequence listing has been furnished.

4. [X] The amendments have resulted in the cancellation of:

[X] the description, pages NONE

[X] the claims, Nos. NONE

[X] the drawings, sheets/fig NONE

5. [X] This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

*** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US99/26126

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. statement

Novelty (N)	Claims	1-75	YES
	Claims	NONE	NO
Inventive Step (IS)	Claims	11-24, 35-48, and 57-75	YES
	Claims	1-10, 25-34, and 49-56	NO
Industrial Applicability (IA)	Claims	1-75	YES
	Claims	NONE	NO

2. citations and explanations (Rule 70.7)

Claims 1-10, 25-34, and 49-56 lacks an inventive step under PCT Article 33(3) as being obvious over US 5,742,283 (KIM).

As to claims 1, 25, 49, and 50, Kim teaches the invention substantially as claimed, comprising: "at least one video input interface for receiving said video information" (col. 1, lines 19-30), "processing said video information by performing video object extraction processing to generate video object descriptions from said video information" (col. 1, lines 38-63), "processing said generated video object descriptions by object hierarchy construction and extraction processing to generate video object hierarchy descriptions" (col. 2, lines 66-67 and lines 3, lines 1-12), processing said generated video object descriptions by entity relation graph generation processing to generate entity relation graph descriptions wherein at least one description record including said video object descriptions (col. 13, lines 23-40), "said video object hierarchy descriptions and said entity relation graph descriptions is generated to represent content embedded within said video information" (col. 13, lines 31-65), and a data storage system, operatively coupled to said processor, for storing said at least one description record" (col. 5, lines 1-15). Kim did not explicitly teach, "a computer processor coupled to at least one video input interface for receiving the video information," however, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a computer processor coupled at least one video input interface for receiving the video information to perform these steps and in view of Kim's teachings (as taught in the background of the invention section, columns 1-2).

With respect to claims 2 and 26, Kim teaches the invention substantially as claimed, "video extraction processing and said object hierarchy construction and extraction processing are performed in parallel" (col. 5, lines 22-48).

With respect to claims 3 and 27, Kim teaches, "the video object extraction processing comprises: video segmentation processing to segment each video in said video information into regions within (Continued on Supplemental Sheet.)

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

CLASSIFICATION:
The International Patent Classification (IPC) and/or the National classification are as listed below:
IPC(7): GO6F 17/30 and US Cl.: 707/1, 103, 204; 345/327, 418, 430, 431, 439, 475; 348/154, 155, 429.

I. BASIS OF REPORT:

5. (Some) amendments are considered to go beyond the disclosure as filed:
NONE

V. 2. REASONED STATEMENTS - CITATIONS AND EXPLANATIONS (Continued):
said video" (col. 5, lines 16-21), "feature extraction and annotation processing to generate one or more feature descriptions for one or more said regions" (col. 1, lines 53-63 and col. 48-65), and "said generated video object descriptions comprise said one or more feature descriptions for one or more said regions" (col. 5, lines 66-67 and col. 6, lines 1-16). Kim did not teach annotation processing, however, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have annotation processing in performing step 1, because annotation is a way of adding a comment or an explanation to the descriptions of the regions of the video information.

With respect to claims 4 and 28, Kim teaches the invention substantially as claimed, "said regions are selected from the group consisting of local, segment, and global regions" (col. 5, lines 2-7).

With respect to claims 5, 29, and 51,Kim teaches the invention substantially as claimed, "said one or more feature descriptions are selected from the group consisting of media features, visual features, temporal features, and semantic features" (col. 5, lines 10-15, lines 22-28, and lines 48-51).

With respect to claims 6, 30, and 52, Kim taught, "said semantic features are further defined by at least one feature description selected from the group consisting of who, what object, what action, where, when, why, and text annotation" (col. 4, lines 12-37). Kim did not explicitly teach the group consisting of who, what object, where, when , why, and text annotation, however, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have semantic features with a description selected from a group because the playing of the document can be altered by the definition and occurrence of the who, what object, where, when, why, and text annotation.

With respect to claims 7, 31, and 53, Kim did not explicitly teach, "the visual features are further defined by at least one feature description selected from the group consisting of color , texture, position, size, shape, motion, camera motion, editing effect, and orientation, but it would have been obvious to one having ordinary skill in the art at the time the invention was made to have visual features defined by color, texture, position, size, shape, motion, camera motion, editing effect, and orientation because the spacial characteristics include the shape size,color, texture, position,motion, camera motion, editing effect, and orientation of the episode on display (see col. 4, lines 48-67).

With respect to claims 8, 32, and 54, Kim does not teach, "media features are further defined by at least one feature description selected from the group consisting of media features of file format, file size, color representation, resolution, data file location, author, creation, scalable layer, and modality transcoding but it would have been obvious to one having ordinary skill in the art at the time the invention was made to have media features consisting of file format, file size, color representation, resolution, data file location, author, creation, scalable layer, and modality transcoding because the episodes of the temporal layout are organized into groups called temporal cliques and independently conform to their own spatial organization of media features.

With respect to claims 9, 33, and 55, Kim teaches, "the temporal features are further defined by at least one feature description selected from the group consisting of start time, end time, and duration" (col. 6, lines 6-16).

With respect to claims 10, 34, 56, Kim teaches, "said object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on visual feature relationships of video objects represented by said video object descriptions" (column 12, lines 51-64).

Claims 11-24, 35-48, and 57-75 meets the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

fairly suggest: As to claims 11-24, 35-48, and 57-75, the object hierarchy construction and extraction process generating video hierarchy descriptions of the video object descriptions based on semantic feature relationships of the video objects represented by the video object descriptions and based on the media feature relationships, the hierarchical levels comprising clustering hierarchies and multiple levels of abstraction hierarchies, taken together with the other claim limitations were not disclosed by the prior art of record.

Claims 1-75 meets the criteria set out in PCT Article 33(4), because the techniques used for describing multimedia information and video information and the content of such information can be used to allow consumers and businesses to search for textual information on the World Wide Web.

RESPONSE TO ARGUMENTS

Applicants' arguments have been considered but are not persuasive in view of the original grounds of rejection. Examiner considers the Applicants' claim limitations of "the generation of video object descriptions by performing video object extraction processing to generate video object descriptions" or "the generation of video object hierarchies by object hierarchy construction and extraction processing to generate video object hierarchy descriptions" as not being found in claims 1, 25, and 49. The claim limitations for claim 1, recites "processing said video information by performing object extraction processing to generate video object descriptions by object hierarchy construction and extraction processing to generate video object hierarchy descriptions ..." Claim 25 recites "processing said video information by performing video object extraction processing to generate video object descriptions from said video object information; processing said generated video object descriptions by object hierarchy construction and extraction processing to generate video object hierarchy descriptions..." Claim 49 recites "one or more object descriptions generated from said video information using video object extraction processing; one or more video object descriptions generated from said generated video object descriptions using object hierarchy construction and extraction processing." Therefore, the Examiner considers the Kim reference to teach the limitations of claims 1, 25, and 49 as recited in the above rejection.

---------- NEW CITATIONS ----------
NONE

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

TO

WRITTEN OPINION

(PCT Rule 66)

To: HENRY TANG
BAKER & BOTTS, LLP
30 ROCKEFELLER PLAZA
NEW YORK, NY 10112-0228

Date of Mailing *(day/month/year)*	29 NOV 2000
Applicant's or agent's file reference: 32283-PCT	REPLY DUE: within TWO months from the above date of mailing

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US99/26126	05 NOVEMBER 1999	06 NOVEMBER 1998

International Patent Classification (IPC) or both national classification and IPC
Please See Supplemental Sheet.

Applicant
THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

1. This written opinion is the first (first, etc.) drawn by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

- I [X] Basis of the opinion
- II [ ] Priority
- III [ ] Non-establishment of opinion with regard to novelty, inventive step or industrial applicability
- IV [ ] Lack of unity of invention
- V [X] Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI [ ] Certain documents cited
- VII [ ] Certain defects in the international application
- VIII [ ] Certain observations on the international application

Docketed
For 1/25/2001 By

3. The applicant is hereby invited to reply to this opinion.

When? See the time limit indicated above. ~~The applicant may, before the expiration of that time limit, request this Authority to grant an extension., see Rule 66.2(d).~~

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also For an additional opportunity to submit amendments, see Rule 66.4.
For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 *bis*.
For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 06 MARCH 2001

Name and mailing address of the IPEA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	HOSAIN ALAM
Facsimile No. (703) 305-3230	Telephone No. (703) 308-6662

Form PCT/IPEA/408 (cover sheet) (July 1998)*

I. Basis of the opinion

1. With regard to the **elements** of the international application:*

[X] the international application as originally filed

[X] the description:
pages 1-46 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of

[X] the claims:
pages 47-61 , as originally filed
pages NONE , as amended (together with any statement) under Article 19
pages NONE , filed with the demand
pages NONE , filed with the letter of

[X] the drawings:
pages 1-16 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of

[X] the sequence listing part of the description:
pages NONE , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

[ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

[ ] the language of publication of the international application (under Rule 48.3(b)).

[ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the written opinion was drawn on the basis of the sequence listing:

[ ] contained in the international application in printed form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readable form.

[ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] The statement that the information recorded in computer readable form is identical to the writen sequence listing has been furnished.

4. [X] The amendments have resulted in the cancellation of:

[X] the description, pages NONE

[X] the claims, Nos. NONE

[X] the drawings, sheets/~~fig~~ NONE

5. [ ] This opinion has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed".*

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII Sheet 10

TIME LIMIT:

The time limit set for response to a Written Opinion may not be extended. 37 CFR 1.484(d). Any response received after the expiration of the time limit set in the Written Opinion will not be considered in preparing the International Preliminary Examination Report.

CLASSIFICATION:

The International Patent Classification (IPC) and/or the National classification are as listed below:
IPC(7): G06F 17/30 and US Cl.: 707/1, 103, 204; 345/327, 418, 430, 431, 439, 475; 348/154, 155, 429.

V. 2. REASONED STATEMENTS - CITATIONS AND EXPLANATIONS (Continued):
said video" (col. 5, lines 16-21), "feature extraction and annotation processing to generate one or more feature descriptions for one or more said regions" (col. 1, lines 53-63 and col. 48-65), and "said generated video object descriptions comprise said one or more feature descriptions for one or more said regions" (col. 5, lines 66-67 and col. 6, lines 1-16). Kim did not teach annotation processing, however, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have annotation processing in performing step 1, because annotation is a way of adding a comment or an explanation to the descriptions of the regions of the video information.

With respect to claims 4 and 28, Kim teaches the invention substantially as claimed, "said regions are selected from the group consisting of local, segment, and global regions" (col. 5, lines 2-7).

With respect to claims 5, 29, and 51,Kim teaches the invention substantially as claimed, "said one or more feature descriptions are selected from the group consisting of media features, visual features, temporal features, and semantic features" (col. 5, lines 10-15, lines 22-28, and lines 48-51).

With respect to claims 6, 30, and 52, Kim taught, "said semantic features are further defined by at least one feature description selected from the group consisting of who, what object, what action, where, when, why, and text annotation" (col. 4, lines 12-37). Kim did not explicitly teach the group consisting of who, what object, where, when , why, and text annotation, however, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have semantic features with a description selected from a group because the playing of the document can be altered by the definition and occurrence of the who, what object, where, when, why, and text annotation.

With respect to claims 7, 31, and 53, Kim did not explicitly teach, "the visual features are further defined by at least one feature description selected from the group consisting of color , texture, position, size, shape, motion, camera motion, editing effect, and orientation, but it would have been obvious to one having ordinary skill in the art at the time the invention was made to have visual features defined by color, texture, position, size, shape, motion, camera motion, editing effect, and orientation because the spacial characteristics include the shape size,color, texture, position,motion, camera motion, editing effect, and orientation of the episode on display (see col. 4, lines 48-67).

With respect to claims 8, 32, and 54, Kim does not teach, "media features are further defined by at least one feature description selected from the group consisting of media features of file format, file size, color representation, resolution, data file location, author, creation, scalable layer, and modality transcoding but it would have been obvious to one having ordinary skill in the art at the time the invention was made to have media features consisting of file format, file size, color representation, resolution, data file location, author, creation, scalable layer, and modality transcoding because the episodes of the temporal layout are organized into groups called temporal cliques and independently conform to their own spatial organization of media features.

With respect to claims 9, 33, and 55, Kim teaches, "the temporal features are further defined by at least one feature description selected from the group consisting of start time, end time, and duration" (col. 6, lines 6-16).

With respect to claims 10, 34, 56, Kim teaches, "said object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on visual feature relationships of video objects represented by said video object descriptions" (column 12, lines 51-64).

Claims 11-24, 35-48, and 57-75 meets the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII Sheet 11

fairly suggest: As to claims 11-24, 35-48, and 57-75, the object hierarchy construction and extraction process generating video hierarchy descriptions of the video object descriptions based on semantic feature relationships of the video objects represented by the video object descriptions and based on the media feature relationships, the hierarchical levels comprising clustering hierarchies and multiple levels of abstraction hierarchies, taken together with the other claim limitations were not disclosed by the prior art of record.

Claims 1-75 meets the criteria set out in PCT Article 33(4), because the techniques used for describing multimedia information and video information and the content of such information can be used to allow consumers and businesses to search for textual information on the World Wide Web.

---------- NEW CITATIONS ----------
NONE

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,555,354 A (STRASNICK et al) 10 September 1996, col. 6, lines 4-67, col. 7, lines 1-38, col. 8, lines 9-47, col. 9, lines 37-44 and lines 66-67, col. 10, lines 1-23, col. 12, lines 1-42, col. 15, lines 20-67, col. 16, lines 1-47, col. 17, lines 6-18, col. 19, lines 57-67, col. 20, lines 52-67, col. 21, lines 6-47, col. 22, lines 16-50, col. 23, lines 49-53, col. 26, lines 49-67, col. 27, lines 1-5, and lines 21-62, and col. 30, lines 37-44.	1-75
Y	US 5,742,283 A (KIM) 21 April 1998, col. 1, lines 19-67, col. 2, lines 1-67, col. 3, lines 1-12 and lines 58-65, col. 4, lines 8-67, col. 5, lines 22-67, col. 6, lines 1-41, col. 7, lines 2-56, col. 10, lines 18-67, col. 11, lines 1-22 and lines 39-67, col. 12, lines 1-67, col. 13, lines 1-67, col. 14, lines 41-63, col. 15, lines 28-67, col. 16, lines 1-67, col. 17, lines 1-9 and lines 17-45, and col. 18, lines 1-43.	1-75

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06F 17/30

US CL :Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 707/1, 103, 204; 345/327, 418, 430, 431, 439, 475; 348/154, 155, 429.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,821,945 A (YEO et al) 13 October 1998, col. 1, lines 31-67, col. 2, lines 1-67, col. 3, lines 1-67, col. 4, lines 1-67, col. 5, lines 1-2 and 23-67, col. 6, lines 1-67, col. 7, lines 1-67, col. 8, lines 1-67, col. 9, lines 1-67, col. 10, lines 1-67, col. 11, lines 1-6 and lines 16-40, and col. 12, lines 1-38.	1-75

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 APRIL 2000	10 MAY 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer HOSAIN ALAM Telephone No. (703) 308-6662

Form PCT/ISA/210 (second sheet) (July 1998)★

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
TANG, Henry
Baker & Botts, LLP
30 Rockefeller Plaza
New York, NY 10112-0228
ETATS-UNIS D'AMERIQUE

BAKER BOTTS L.L.P.
00 MAY 30 PM 1:01

Date of mailing (day/month/year) 18 May 2000 (18.05.00)	
Applicant's or agent's file reference 32283-PCT	**IMPORTANT NOTICE**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/US99/26126	05 November 1999 (05.11.99)	06 November 1998 (06.11.98)

Applicant
THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   AU,CN,JP,KP,KR,MA,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CR,CU,CZ,DE,DK,DM,EA,EE,EP,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW
   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   18 May 2000 (18.05.00) under No. WO 00/28725

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

Form PCT/IB/308 (July 1996) 3277915

Encl. in pocket

CM

F ... the INTERNATIONAL SEARCHING AUTHORITY

o: HENRY TANG
BAKER & BOTTS, LLP
30 ROCKEFELLER PLAZA
NEW YORK, NY 10112-0228

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

	Date of Mailing *(day/month/year)* 10 MAY 2000
Applicant's or agent's file reference 32283-PCT	FOR FURTHER ACTION See paragraphs 1 and 4 below
International application No. PCT/US99/26126	International filing date *(day/month/year)* 05 NOVEMBER 1999
Applicant THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK	

1. [X] The applicant is hereby notified that the international search report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the international search report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

Docketed
For 7/10/2000 By

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. [ ] **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in rules 90 *bis* 1 and 90 *bis* 3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer HOSAIN ALAM
Facsimile No. (703) 305-3230	Telephone No. (703) 308-6662

Form PCT/ISA/220 (July 1998)* *(See notes on accompanying sheet)*

COPY TO
MCW 5/18/00 X Copy of Search report & Refernces in docketing

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 32283-PCT	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/US99/26126	International filing date *(day/month/year)* 05 NOVEMBER 1999	(Earliest) Priority Date *(day/month/year)* 06 NOVEMBER 1998
Applicant THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 5 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:
   [ ] contained in the international application in written form.
   [ ] filed together with the international application in computer readable form.
   [ ] furnished subsequently to this Authority in written form.
   [ ] furnished subsequently to this Authority in computer readable form.
   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.
2. [ ] **Certain claims were found unsearchable** (See Box I).
3. [ ] **Unity of invention is lacking** (See Box II).
4. With regard to the **title**,
   [X] the text is approved as submitted by the applicant.
   [ ] the text has been established by this Authority to read as follows:
5. With regard to the **abstract**,
   [ ] the text is approved as submitted by the applicant.
   [X] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. The figure of the **drawings** to be published with the abstract is Figure No. 2
   [ ] as suggested by the applicant.
   [X] because the applicant failed to suggest a figure.
   [ ] because this figure better characterizes the invention.
   [ ] None of the figures.

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

NEW ABSTRACT

Systems and methods for describing video content establishing video descriptions records which include an object set (24), an object hierarchy (26) and entity relation graphs (28). Video objects can include global objects, segment objects, and local objects. The video objects are further defined by a number of features organized in classes, which in turn are defined by a number of feature descriptors (36), (38), and (40). The relationships (44) between and among the objects in the object set (24) are defined by the object hierarchy (26) and entity relation graphs (28). The video description records provide a standard vehicle for describing the content and context of video information for subsequent access and processing by computer applications such as search engines, filters, and archive systems.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under Article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

The statement should be brief, it should not exceed 500 words if in English or if translated into English.

It should not be confounded with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It should not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

In what language ?

The amendments must be made in the language in which the international application is published. The letter and any statement accompanying the amendments must be in the same language as the international application if that language is English or French; otherwise, it must be in English or French, at the choice of the applicant.

Consequence if a demand for international preliminary examination has already been filed ?

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase ?

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under Article 19. The Notes are based on the requirements of the Patent Cooperation Treaty and of the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule" and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended ?

The claims only.

The description and the drawings may only be amended during international preliminary examination under Chapter II.

When ? **Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).**

Where not to file the amendments ?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How ? **Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.**

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

What documents must/may accompany the amendments ?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confounded with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

(i) the claim is unchanged;
(ii) the claim is cancelled;
(iii) the claim is new;
(iv) the claim replaces one or more claims as filed;
(v) the claim is the result of the division of a claim as filed.

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

TANG, Henry
Baker & Botts, LLP
30 Rockefeller Plaza
New York, NY 10112-0228
ÉTATS-UNIS D'AMÉRIQUE

BAKER BOTTS L.L.P.
00 FEB 15 PM 2:17
TO

Date of mailing (day/month/year) 08 February 2000 (08.02.00)	
Applicant's or agent's file reference 32283-PCT	IMPORTANT NOTIFICATION
International application No. PCT/US99/26126	International filing date (day/month/year) 05 November 1999 (05.11.99)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 06 November 1998 (06.11.98)
Applicant THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.

3. An **asterisk(*)** appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

4. The **letters "NR"** appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
06 Nove 1998 (06.11.98)	60/107,463	US	24 Janu 2000 (24.01.00)
01 Febr 1999 (01.02.99)	60/118,020	US	24 Janu 2000 (24.01.00)
01 Febr 1999 (01.02.99)	60/118,027	US	24 Janu 2000 (24.01.00)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer
Carlos Naranjo

Telephone No. (41-22) 338.83.38

TANG, Henry
Baker & Botts, LLP
30 Rockefeller Plaza
New York, NY 10112-0228

FROM: FOREIGN MAIL DESK

PLEASE BE ADVISED THAT THERE ARE 2 PIECES OF MAIL.

ETATS-UNIS D'AMERIQUE

Datum/Date: 25/05/00

Zeichen/Ref./Réf.	Anmeldung Nr./Application No./Demande n°./Patent Nr./Patent No./Brevet n°.
	99960214.7- -PCT/US9926126

Anmelder/Applicant/Demandeur/Patentinhaber/Proprietor/Titulaire:
THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF

NOTE: The following information concerns the steps which you are required to take for entry into the regional phase before the EPO. You are strongly advised to read it carefully. Failure to take the appropriate steps in due time could lead to the application being deemed withdrawn.

1. European patent application no. 99960214.7 has been allotted to the above-mentioned international patent application.

2. Applicants having neither a residence nor their principal place of business within the territory of one of the EPC Contracting States may initiate the regional (European) processing of the international application themselves, provided they do so before expiry of the 21st or 31st month as from the priority date (see Legal Advice of the EPO no. 18/92 published in OJ EPO 1992, 58).

   Note, however, that such applicants must be represented in the regional phase before the EPO as designated or elected Office by a professional representative whose name appears on the EPO list of representatives (Arts. 133(2) and 134(1) EPC).

   After expiry of the 21st or 31st month, any procedural steps which are taken by the representative of the applicant in the international phase, who is not, however, entitled to practise before the EPO, will have no effect and will, thus, result in loss of rights.

   The appointment of a professional representative entitled to practise before the EPO is possible/advisable at an early stage during the international phase (any time after the 14th month from the priority date) in view of representing applicants before the EPO as designated or elected Office.

ON DOCKET FOR 10/11/00

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EPO FORM 1201 (08.98)

18/05/00
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Therefore, an appointment in due time is strongly recommended, if it is intended that this representative should already act for entry into the regional phase, otherwise all communications will be forwarded from the EPO directly to the applicant.

3. Applicants having their address within the territory of one of the EPC Contracting States are not obliged to appoint a professional representative entitled to practise before the EPO to represent them in the regional phase where the EPO is designated or elected Office.

   Note that due to the complexity of the proceedings, applicants are strongly advised to appoint such representative. Please keep in mind that, if a professional representative before the EPO has already acted for the applicant during the international phase, this representative is not automatically regarded as the representative for the regional phase.

4. Applicants and professional representatives are recommended to file EPO Form 1200 (available free of charge from the EPO) for entry into the regional phase. The use of Form 1200, however, is not mandatory.

5. FOR ENTRY INTO THE REGIONAL PHASE BEFORE THE EPO the following procedural steps must be taken. (Note that non-completion or ineffective completion of the required steps will result in loss of rights or other disadvantage.)

   5.1 Within 21 months from the date of filing or (where applicable) from the earliest priority date if the EPO acts as DESIGNATED OFFICE pursuant to Article 22(1) PCT:

   a) Filing of a translation of the international application in an EPO official language if the International Bureau did not publish the application in one of those languages (Art. 22(1) PCT and Rule 104b(1)(a) EPC).
   Note that if such translation is not filed in due time, the international application before the EPO is deemed withdrawn (Art. 24(1)(iii) PCT).

   b) Payment of the national fee [national basic fee, the designation fee for each State designated, (where applicable) the claims fees for the eleventh and each subsequent claim] and the search fee, where a supplementary European search report has to be drawn up (Rule 104b(1)(b), (c) EPC).

   Upon expiry of the 21-month time limit provided for in Rule 104b(1) EPC the EPO sends the applicant or his appointed professional representative the communication pursuant to Rule 85a(1) EPC (Form 1217) and (where applicable) Rule 69(1) EPC (Form 1205)

unless it has been notified of its designation as elected Office in due time.

5.2 Within 31 months from the date of filing or (where applicable) from the earliest priority date if the EPO acts as ELECTED OFFICE pursuant to Article 39(1)(a) PCT:

a) Filing of a translation as under 5.1 a).

b) Payment of the fees as under 5.1 b).

c) Filing of the written request for examination and payment of the examination fee (Rule 104b(1)(d) EPC).
Note that both acts must be performed in due time, otherwise the European patent application shall be deemed to be withdrawn (Art. 94(3) EPC).

d) Payment of the renewal fee for the third year, if due before the expiration of the 31-month term (Rule 104b(1)(e) EPC).

6. The amounts of the fees (and equivalents in all currencies of the contracting states of the EPC) are regularl y published in the Official Journal of the EPO.

If the national basic fee, the designation fees or the search fee have not been paid in time, they may still be validly paid within a grace period of one month as from notification of an EPO communication (Rule 85a(1) EPC).

If the renewal fee is not paid in time, it may still be validly paid within six months from the due date (Art. 86(2) EPC).

In both cases, a surcharge is due.

7. The international search report under Article 18 PCT (or the declaration under Article 17(2)(a) PCT) has been published by the International Bureau. The date of publication can be ascertained from the copy of the published application documents sent by the International Bureau or from the international search report, if published separately. This publication takes the place of the mention of the publication of the European search report (Art. 157(1) EPC).

A request for examination, comprising a written request and payment of the examination fee, must be filed up to the end of six months after the above date.

However, in view of Article 22 or 39 PCT in conjunction with Rule 104b(1)(d) EPC, the period for filing the request for examination does not expire before 21 or 31 months, respectively, from the date of filing (where applicable, the earliest priority date).

A period of grace of one month from notification of an EPO communication is available in case either or both of the above acts have not been performed in time. Accordingly, a surcharge is due (Rule 85b EPC).

8. This information letter is addressed by the EPO to the agent, if any, having acted for the applicant during the international phase of the application.

   Any further notifications on procedural matters will be addressed to the applicant, respectively his European representative, if the appointment of the latter has been communicated to the EPO in due time.

9. For further details see the information for PCT applicants concerning time limits and procedural steps before the EPO as a designated and as an elected Office under the PCT (published as Supplement No. 1 to OJ EPO 12/1992, with changes published in OJ EPO 1994, 131).

   Concerning the list of professional representatives before the European Patent Office (see points 2 and 3), EPO Form 1200 (see point 4) and the actual fees to be paid (see point 6) we refer to the EPO's Internet address:
   http://www.european-patent-office.org.

RECEIVING SECTION

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF RECEIPT OF RECORD COPY

(PCT Rule 24.2(a))

To: BAKER BOTTS L.L.P.

00 FEB -7 PM 12:05

TANG, Henry
Baker & Botts, LLP
30 Rockefeller Plaza
New York, NY 10112-0228
ÉTATS-UNIS D'AMÉRIQUE

Date of mailing (day/month/year)	IMPORTANT NOTIFICATION
26 January 2000 (26.01.00)	
Applicant's or agent's file reference	**International application No.**
32283-PCT	PCT/US99/26126

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK et al (for all designated States except US)
PAEK, Seungyup et al (for US)

International filing date	:	05 November 1999 (05.11.99)
Priority date(s) claimed	:	06 November 1998 (06.11.98) 01 February 1999 (01.02.99) 01 February 1999 (01.02.99)
Date of receipt of the record copy by the International Bureau	:	06 January 2000 (06.01.00)
List of designated Offices	:	

AP :GH,GM,KE,LS,MW,SD,SL,SZ,TZ,UG,ZW
EA :AM,AZ,BY,KG,KZ,MD,RU,TJ,TM
EP :AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE
OA :BF,BJ,CF,CG,CI,CM,GA,GN,GW,ML,MR,NE,SN,TD,TG
National :AE,AL,AM,AT,AU,AZ,BA,BB,BG,BR,BY,CA,CH,CN,CR,CU,CZ,DE,DK,DM,EE,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KP,KR,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,NO,NZ,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,US,UZ,VN,YU,ZA,ZW

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer:
Beatriz Morariu

Telephone No. (41-22) 338.83.38

Date of mailing (day/month/year)	IMPORTANT NOTIFICATION
26 January 2000 (26.01.00)	
Applicant's or agent's file reference	**International application No.**
32283-PCT	PCT/US99/26126

ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- [X] time limits for entry into the national phase
- [ ] confirmation of precautionary designations
- [X] requirements regarding priority documents

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

INFORMATION ON TIME LIMITS FOR ENTERING THE NATIONAL PHASE

The applicant is reminded that the "national phase" must be entered before each of the designated Offices indicated in the Notification of Receipt of Record Copy (Form PCT/IB/301) by paying national fees and furnishing translations, as prescribed by the applicable national laws.

The time limit for performing these procedural acts is **20 MONTHS** from the priority date or, for those designated States which the applicant elects in a demand for international preliminary examination or in a later election, **30 MONTHS** from the priority date, provided that the election is made before the expiration of 19 months from the priority date. Some designated (or elected) Offices have fixed time limits which expire even later than 20 or 30 months from the priority date. In other Offices an extension of time or grace period, in some cases upon payment of an additional fee, is available.

In addition to these procedural acts, the applicant may also have to comply with other special requirements applicable in certain Offices. **It is the applicant's responsibility** to ensure that the necessary steps to enter the national phase are taken in a timely fashion. Most designated Offices do not issue reminders to applicants in connection with the entry into the national phase.

For detailed information about the procedural acts to be performed to enter the national phase before each designated Office, the applicable time limits and possible extensions of time or grace periods, and any other requirements, see the relevant Chapters of Volume II of the PCT Applicant's Guide. Information about the requirements for filing a demand for international preliminary examination is set out in Chapter IX of Volume I of the PCT Applicant's Guide.

GR and ES became bound by PCT Chapter II on 7 September 1996 and 6 September 1997, respectively, and may, therefore, be elected in a demand or a later election filed on or after 7 September 1996 and 6 September 1997, respectively, regardless of the filing date of the international application. (See second paragraph above.)

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

CONFIRMATION OF PRECAUTIONARY DESIGNATIONS

This notification lists only specific designations made under Rule 4.9(a) in the request. It is important to check that these designations are correct. Errors in designations can be corrected where precautionary designations have been made under Rule 4.9(b). The applicant is hereby reminded that any precautionary designations may be confirmed according to Rule 4.9(c) before the expiration of 15 months from the priority date. If it is not confirmed, it will automatically be regarded as withdrawn by the applicant. There will be no reminder and no invitation. Confirmation of a designation consists of the filing of a notice specifying the designated State concerned (with an indication of the kind of protection or treatment desired) and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.

REQUIREMENTS REGARDING PRIORITY DOCUMENTS

For applicants who have not yet complied with the requirements regarding priority documents, the following is recalled.

Where the priority of an earlier national, regional or international application is claimed, the applicant must submit a copy of the said earlier application, certified by the authority with which it was filed ("the priority document") to the receiving Office (which will transmit it to the International Bureau) or directly to the International Bureau, before the expiration of 16 months from the priority date, provided that any such priority document may still be submitted to the International Bureau before that date of international publication of the international application, in which case that document will be considered to have been received by the International Bureau on the last day of the 16-month time limit (Rule 17.1(a)).

Where the priority document is issued by the receiving Office, the applicant may, instead of submitting the priority document, request the receiving Office to prepare and transmit the priority document to the International Bureau. Such request must be made before the expiration of the 16-month time limit and may be subjected by the receiving Office to the payment of a fee (Rule 17.1(b)).

If the priority document concerned is not submitted to the International Bureau or if the request to the receiving Office to prepare and transmit the priority document has not been made (and the corresponding fee, if any, paid) within the applicable time limit indicated under the preceding paragraphs, any designated State may disregard the priority claim, provided that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity to furnish the priority document within a time limit which is reasonable under the circumstances.

Where several priorities are claimed, the priority date to be considered for the purposes of computing the 16-month time limit is the filing date of the earliest application whose priority is claimed.

From the INTERNATIONAL BUREAU

PCT

INFORMATION CONCERNING ELECTED OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

To:

TANG, Henry
Baker & Botts, LLP
30 Rockefeller Plaza
New York, NY 10112-0228
ETATS-UNIS D'AMERIQUE

BAKER BOTTS L.L.P.
00 SEP 11 PM 2:12

Date of mailing (day/month/year) 28 August 2000 (28.08.00)	
Applicant's or agent's file reference 32283-PCT	**IMPORTANT INFORMATION**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/US99/26126	05 November 1999 (05.11.99)	06 November 1998 (06.11.98)

Applicant
THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK et al

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

   AP :GH,GM,KE,LS,MW,SD,SL,SZ,TZ,UG,ZW
   EP :AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE
   National :AU,BG,BR,CA,CN,CZ,DE,IL,JP,KP,KR,MN,NO,NZ,PL,RO,RU,SE,SK,US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

   EA :AM,AZ,BY,KG,KZ,MD,RU,TJ,TM
   OA :BF,BJ,CF,CG,CI,CM,GA,GN,GW,ML,MR,NE,SN,TD,TG
   National :AE,AL,AM,AT,AZ,BA,BB,BY,CH,CR,CU,DK,DM,EE,ES,FI,GB,GD,GE,GH,GM,
   HR,HU,ID,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MW,MX,PT,SD,SG,
   SI,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW

3. The applicant is reminded that he must enter the "national phase" **before the expiration of 30 months from the priority date** before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing , if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

   Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

   The entry into the European regional phase is postponed **until 31 months from the priority date** for all States designated for the purposes of obtaining a European patent.

Docketed
For 5 16 /2001 By S.O.

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer: Manu Berrod
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

Form PCT/IB/332 (September 1997)

3491878

00 JUL 31 7:11: 13

PCT

To:

HENRY TANG
BAKER & BOTTS, LLP
30 ROCKEFELLER PLAZA
NEW YORK NY 10112-0228

NOTIFICATION OF RECEIPT OF DEMAND BY COMPETENT INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

(PCT Rule 59.3(e) and 61.1(b), first sentence and Administrative Instructions, Section 601(a))

Date of mailing *(day/month/year)*	26 JUL 2000
Applicant's or agent's file reference: 32283-PCT	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US99/26126	05 NOV 99	06 NOV 98

Applicant: THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

1. The applicant is hereby notified that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

   05 June 2000 (05.06.00)

2. That date of receipt is:

   - [x] the actual date of receipt of the demand by this Authority (Rule 61.1(b)).
   - [ ] the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).
   - [ ] the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

3. [ ] **ATTENTION**: That date of receipt is **AFTER** the expiration of 19 months from the priority date. Consequently, the election(s) made in the demand does (do) not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22). For details, see the *PCT Applicant's Guide*, Volume II.

   [ ] *(If applicable)* This notification confirms the information given by telephone, facsimile transmission or in person on: _____

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Docketed
For 8 /26 /2000 B

Name and mailing address of the IPEA/US	Authorized officer
Assistant Commissioner for Patents Box PCT Washington, D.C. 20231 Attn: IPEA/US Facsimile No.	Jeannette Washington PCT Operations - IAFD Team 1 Telephone No. (703) 305-3687 (703) 305-3230 (FAX)

Form PCT/IPEA/402 (July 1998)

I. **Certification under 37 CFR 1.10 (if applicable)**

EJ339573419US	5 June 2000
Express Mail mailing number	Date of Deposit

I hereby certify that the application/correspondence attached hereto is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to Assistant Commissioner for Patents, Washington, D.C. 20231.

Leroy Chick	Leroy Chick
Signature of person mailing correspondence	Typed or printed name of person mailing correspondence

II. ☐ **New International Application**

TITLE		Earliest priority date (Day/Month/Year)

SCREENING DISCLOSURE INFORMATION: In order to assist in screening the accompanying international application for purposes of determining whether a license for foreign transmittal should and could be granted and for other purposes, the following information is supplied. (Note: check as many boxes as apply):

A. ☐ The invention disclosed was **not** made in the United States.

B. ☐ There is no prior U.S. application relating to this invention.

C. ☐ The following prior U.S. application(s) contain subject matter which is related to the invention disclosed in the attached international application. *(NOTE: priority to these applications may or may not be claimed on form PCT/RO/101 (Request) and this listing does not constitute a claim for priority).*

application no.		filed on	
application no.		filed on	

D. ☐ The present international application ☐ is identical ☐ contains less subject matter than that found in the prior U.S. application(s) identified in paragraph C.

E. ☐ The present international application ☐ contains additional subject matter not found in the prior U.S. application(s) identified in paragraph C. above. The additional subject matter is found on pages ____ and ☐ **DOES NOT ALTER** ☐ **MIGHT BE CONSIDERED TO ALTER** the general nature of the invention in a manner which would require the U.S. application to have been made available for inspection by the appropriate defense agencies under 35 U.S.C. 181 and 37 CFR 5.1. See 37 CFR 5.15

III. ☐ **A Response to an Invitation from the RO/US.** The following document(s) is (are) enclosed:

A. ☐ A Request for An Extension of Time to File a Response

B. ☐ A Power of Attorney (General or Regular)

C. ☐ Replacement pages:

pages		of the request (PCT/RO/101)	pages		of the figures
pages		of the description	pages		of the abstract
pages		of the claims			

D. ☐ Submission of Priority Documents

Priority document		Priority document	

E. ☐ Fees as specified on attached Fee Calculation sheet form PCT/RO/101 annex

IV. ☐ **A Request for Rectification under PCT 91** ☐ **A Petition** ☐ **A Sequence Listing Diskette**

V. ☒ **Other** (please specify): Demand for International Preliminary Examination (6 sheets), Fee Calculation Sheet, a postcard, and a check in the amount of $643.

The person signing this form is the:		
	☐ Applicant	Paul A. Ragusa
	☒ Attorney/Agent (Reg. No.) 38,587	Typed name of signer
	☐ Common Representative	Signature

PTO-1382 (Rev. 4-1995)

U.S. Department of Commerce: Patent and Trademark Office

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only

Identification of IPEA	Date of receipt of DEMAND

Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION

Applicant's or agent's file reference: 32283-PCT

International application No.	International filing date *(day/month/year)*	(Earliest) Priority date *(day/month/year)*
PCT/US99/26126	05 November 1999 (05.11.99)	06 November 1998 (06.11.98)

Title of invention
VIDEO DESCRIPTION SYSTEM AND METHOD

Box No. II APPLICANT(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK
Broadway and 116th Street
New York, NY 10027
US

Telephone No.:

Facsimile No.:

Teleprinter No.:

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
US	US

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

AT&T
AT&T Labs, Room 3-237
100 Schultz Drive-Middletown
Redbank, NJ 07701
US

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
US	US

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

IBM
T.J. Watson Research Center
30 Saw Mill River Road
Hawthorne, NY 10532
US

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
US	US

☒ Further applicants are indicated on a continuation sheet.

Continuation of Box No. II APPLICANT(S)

If none of the following sub-boxes is used, this sheet is not to be included in the demand.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

PAEK, SEUNGYUP
530 Riverside Drive, Apt. 6J
New York, NY 10027
US

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
KR	US

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

BENITEZ, ANA
400 West 119th Street, Apt. 9F
New York, NY 10027
US

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
ES	US

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

CHANG, SHIH-FU
560 Riverside Drive, Apt. 18K
New York, NY 10027
US

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
TW	US

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(that is, country)* of nationality:	State *(that is, country)* of residence:

☒ Further applicants are indicated on another continuation sheet.

Continuation of Box No. II APPLICANT(S)

If none of the following sub-boxes is used, this sheet is not to be included in the demand.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

PURI, ATUL
AT&T Labs, Room 3-237
100 Schultz Drive-Middletown
Redbank, NJ 07701
US

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
US	US

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

HUANG, QIAN
AT&T Labs, Room 3-237
100 Schultz Drive-Middletown
Redbank, NJ 07701
US

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
US	US

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

LI, CHUNG-SHENG
50 Croton Avenue, Apt. 2C
Ossining, NY 10562
US

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
US	US

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

SMITH, JOHN R.
275 West 96th Street, Apt. 15B
New York, NY 10025
US

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
US	US

☒ Further applicants are indicated on another continuation sheet.

Continuation of Box No. II APPLICANT(S)

If none of the following sub-boxes is used, this sheet is not to be included in the demand.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

BERGMAN, LAWRENCE
IBM
T.J. Watson Research Center
30 Saw Mill River Road
Hawthorne, NY 10532
US

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
US	US

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(that is, country)* of nationality:	State *(that is, country)* of residence:

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(that is, country)* of nationality:	State *(that is, country)* of residence:

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(that is, country)* of nationality:	State *(that is, country)* of residence:

☐ Further applicants are indicated on another continuation sheet.

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The following person is ☒ agent ☐ common representative

and ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.

☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.

☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

TANG, HENRY
Baker Botts, LLP
30 Rockefeller Plaza
New York, NY 10112-0228
US

Telephone No.: (212) 705-5000

Facsimile No.: (212) 705-5020

Teleprinter No.:

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION

Statement concerning amendments:*

1. The applicant wishes the international preliminary examination **to start on the basis of:**

☒ the international application as originally filed

the description ☐ as originally filed
☐ as amended under Article 34

the claims ☐ as originally filed
☐ as amended under Article 19 (together with any accompanying statement)
☐ as amended under Article 34

the drawings ☐ as originally filed
☐ as amended under Article 34

2. ☐ The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.

3. ☐ The applicant wishes the start of the international preliminary examination **to be postponed** until the expiration of 20 months from the priority date unless the International Preliminary Examing Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: English

☒ which is the language in which the international application was filed.
☐ which is the language of a translation furnished for the purposes of international search.
☐ which is the language of publication of the international application.
☐ which is the language of the translation (to be) furnished for the purposes of international preliminary examination.

Box No. V ELECTION OF STATES

The applicant hereby **elects all eligible States** *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes **not to elect:**

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:			For International Preliminary Examining Authority use only: received	not received
1. translation of international application	:	sheets	☐	☐
2. amendments under Article 34	:	sheets	☐	☐
3. copy (or, where required, translation) of amendments under Article 19	:	sheets	☐	☐
4. copy (or, where required, translation) of statement under Article 19	:	sheets	☐	☐
5. letter	:	sheets	☐	☐
6. other *(specify)*	:	sheets	☐	☐

The demand is also accompanied by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ nucleotide and or amino acid sequence listing in computer readable form
6. ☒ other *(specify)*: Transmittal Letter

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

Paul A. Ragusa (Agent)

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:
2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):
3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply. ☐ The applicant has been informed accordingly.
4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.
5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on:

APPENDIX A: Document Type Definition of Video Description Scheme

video_ds.dtd:

```
<!-- Video DS -->

<!-- Entities are like macros. They can be referenced by using the notation "%EntityName;" --
>
<!-- For clarity, we have chosen not to reference them in this DTD, although some of them
are derived from the Image DTD -->
<!-- Some of the elements in this DTD are inherited from the image DTD: object_hierarchy,
entity_relation_graph, etc. We have included some of them in this annex. -->
<!ENTITY % video_object_elements "
        vid_obj_media_features?,
        vid_obj_semantic_features?,
        vid_obj_visual_features?,
        vid_obj_temporal_features?">

<!ENTITY % ref_video_object_attributes "
        %image_object_attributes;">

<!ENTITY % only_vid_obj_media_features_elements "
        bit_rate?">

<!ENTITY % vid_obj_media_features_elements "
        %img_obj_media_features_elements;
        %only_vid_obj_media_features_elements;">

<!ENTITY % vid_obj_semantic_features_elements "
        %img_obj_semantic_features_elements;">

<!ENTITY % only_vid_obj_visual_features_elements "
        video_scl?, visual_sprite?, transition?, camera_motion?, size?, key_frame*">

<!ENTITY % vid_obj_visual_features_elements "
        %img_obj_visual_features_elements;
        %only_vid_obj_visual_features_elements;">

<!ENTITY % vid_obj_temporal_features_elements "
        time?">
```

```
<!ELEMENT video (video_object_set, event_hierarchy*, entity_relation_graph*)>
<!ATTLIST video
        id ID #IMPLIED>


<!ELEMENT video_object_set (video_object+)>

<!ELEMENT video_object (vid_obj_media_features?, vid_obj_semantic_features?,
                                vid_obj_visual_features?, vid_obj_temporal_features?)>
<!ATTLIST video_object
        type (LOCAL|SEGMENT|GLOBAL) #REQUIRED
        id ID #IMPLIED
        object_ref IDREF #IMPLIED
        object_node_ref IDREFS #IMPLIED
        entity_node_ref IDREFS #IMPLIED>

<!ELEMENT vid_obj_media_features (
        bit_rate?,
        location?, file_format?, file_size?, resolution?, modality_transcoding?)>

<!ELEMENT vid_obj_semantic_features (text_annotation?, who?, what_action?, where?,
why?,
                                        when?)>

<!ELEMENT vid_obj_visual_features (
        image_scl?, color?, texture?, shape?, size?, position?, motion?,
        video_scl?, visual_sprite?, transition?, camera_motion?, size?, key_frame*)>

<!ELEMENT vid_obj_temporal_features (time?)>

<!-- The object hierarchy and the entity relation graph are defined in the Image DS (Proposal
# 480). We include them in this DTD for convenience. -->

<!-- Object hierarchy element -->
<!-- The attribute type is the hierarchy binding type -->
<!ELEMENT object_hierarchy (object_node)>
<!ATTLIST object_hierarchy
        id ID #IMPLIED
        type CDATA #IMPLIED>
```

```
<!ELEMENT object_node (object_node*)>
<!ATTLIST object_node
        id ID #IMPLIED
        object_ref IDREF #REQUIRED>

<!-- Entity relation graph element-->
<!-- Possible types of entity relations and entity relation graphs:
        - Spatial: topological, directional
        - Temporal: topological, directional
        - Semantic -->
<!ELEMENT entity_relation_graph (entity_relation+)>
<!ATTLIST entity_relation_graph
        id ID #IMPLIED
        type CDATA #IMPLIED>

<!ELEMENT entity_relation (relation, (entity_node | entity_node_set | entity_relation)*)>
<!ATTLIST entity_relation
        type CDATA #IMPLIED>

<!ELEMENT relation (#PCDATA | code)*>

<!ELEMENT entity_node (#PCDATA)>
<!ATTLIST entity_node
        id ID #IMPLIED
        object_ref IDREF #REQUIRED>

<!ELEMENT entity_node_set (entity_node+)>

<!-- External image DS DTD -->
<!ENTITY % image_ds SYSTEM "image_ds.dtd">
%image_ds;

<!-- External scalable video DTD -->
<!ENTITY % video_scl SYSTEM "video_scl.dtd">
%video_scl;

<!-- External visual sprite DTD -->
<!ENTITY % visual_sprite SYSTEM "visual_sprite.dtd">
%visual_sprite;
```

```
<!-- External transition DTD -->
<!ENTITY % transition SYSTEM "transition.dtd">
%transition;

<!-- External camera motion DTD -->
<!ENTITY % camera_motion SYSTEM "camera_motion.dtd">
%camera_motion;

<!ELEMENT key_frame (size_dimensions?, time_instant?)>

<!-- Video DS end -->
```

location.dtd:

```
<!-- Description of resources' location-->

<!-- Objects, image, videos can be located/accessed at different locations -->
<!ELEMENT location (location_site*)>

<!-- One location site -->
<!ELEMENT location_site EMPTY>
<!ATTLIST location_site
        href CDATA #REQUIRED
        title CDATA #IMPLIED>

<!ELEMENT code (location*)>
<!ATTLIST code
        type (EXTRACTION|DISTANCE) "EXTRACTION"
        language (C|JAVA|PERL) #REQUIRED
        version CDATA #REQUIRED>

<!-- Description of resources' storage location -->
```

video_scl.dtd:

```
<!-- Video scalability features -->

<!ELEMENT video_scl(video_sclobj, code*)
<!ELEMENT video_sclobj(vid_obj_scltype, vid_obj_mode, vid_obj_numlayers, codref,
subsamp_factor, vid_obj_shape?)>
```

```
<!ELEMENT vid_obj_scltype EMPTY>
<!ATTLIST vid_obj_scltype
        typeinfo (DATPARTITION|SPATIAL|TEMPORAL|SNR) #REQUIRED>

<!-- Video scalability (subtype) mode features -->
<!ELEMENT vid_obj_mode EMPTY>
<!ATTLIST vid_obj_mode
        modeinfo CDATA #REQUIRED>

<!ELEMENT numlayers EMPTY>
<!ATTLIST vid_obj_numlayers
        numval #REQUIRED>

<!ELEMENT codref EMPTY>
<!ATTLIST codref
        layernum #REQUIRED>

<-- subsampling ratio n/m for horizontal and vertical directions -->
<!ELEMENT subsamp_factor EMPTY>
<!ATTLIST subsamp_factor
        hor_factor_n CDATA #REQUIRED
        hor_factor_m CDATA #REQUIRED
        vert_factor_n CDATA #REQUIRED
        vert_factor_m CDATA #REQUIRED>

<!ELEMENT vid_obj_shape(shape)>

<!-- scalability features end -->
```

visual_sprite.dtd:

```
<!-- visual sprite features -->

<!ELEMENT visual_sprite (vis_spriteobj)>

<!ELEMENT vis_spriteobj (vis_spritcobj_info, code*)>

<!ELEMENT vis_spriteobj_info (vis_sprite_dim, vis_sprite_shape, vis_sprite_trajectory,
vis_sprite_warp, vis_sprite_brightness, vis_sprite_texture)>

<!ELEMENT vis_sprite_dim (sprite_size, sprite_num_pts, sprite_coord)>
```

```
<!ELEMENT sprite_size EMPTY>
<!ATTLIST sprite_size
        sprite_width CDATA #REQUIRED
        sprite_height CDATA #REQUIRED>

<!ELEMENT sprite_num_pts EMPTY>
<!ATTLIST sprite_num_pts
        num_pts CDATA #REQUIRED>

<!ELEMENT sprite_coord EMPTY>
<!ATTLIST sprite_coord
        xcoord CDATA #REQUIRED
        ycoord CDATA #REQUIRED>

<!ELEMENT vis_sprite_shape (shape)>

<!ELEMENT vis_sprite_trajectory (motion)>

<!ELEMENT vis_sprite_warp EMPTY>
<!ATTLIST vis_sprite_warp
        num_pts CDATA #REQUIRED>

<!ELEMENT vis_sprite_brightness EMPTY>
<!ATTLIST vis_sprite_brightness
        avgbright CDATA #REQUIRED
        varbright CDATA #REQUIRED>

<!ELEMENT vis_sprite_texture (texture)>
```

transition.dtd:

```
<!-- Transition features -->

<!ELEMENT transition (transition_desc1*)>

<!ELEMENT transition_desc1 (transition_desc1_value, code*)>
<!ELEMENT transition_desc1_value (effect)>
<!ELEMENT effect (#PCDATA)>

<!-- Transition features -->
```

camera_motion.dtd:

```
<!-- Camera motion features -->

<!ELEMENT camera_motion (background_affine_motion*)>

<!-- Affine model for camera motion detection -->
<!ELEMENT background_affine_motion (background_affine_motion_value, code*)>

<!ELEMENT background_affine_motion_value (panning?, zoom?)>

<!ELEMENT panning (direction?)>
<!ATTLIST panning
        direction (NT|NE|ET|SE|ST|SW|WT|NW) #REQUIRED>

<!ELEMENT zoom (direction?)>
<!ATTLIST zoom
        direction (IN|OUT) #REQUIRED>

<!ELEMENT direction (#PCDATA)>

<!-- Camera motion features end -->
```

motion.dtd:

```
<!-- Motion features -->

<!ELEMENT motion (affine_model*)>

<!-- Affine motion feature -->
<!ELEMENT affine_model (affine_model_value*, code*)>

<!ELEMENT affine_model_value (parameters?, trajectory?)>

<!ELEMENT parameters (affine_bin*)>
<!ATTLIST parameters
        length CDATA #IMPLIED>

<!ELEMENT affine_bin (#PCDATA)>
<!ATTLIST affine_bin
```

PCT

FEE CALCULATION SHEET

Annex to the Demand for international preliminary examination

International application No.	PCT/US99/26126
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(57) Abstract

Systems and methods for describing video content establish video description records which include an object set, an object hierarchy and entity relation graphs. Video objects can include global ojects, segment objects and local objects. The video objects are further defined by a number of features organized in classes, which in turn are further defined by a number of feature descriptors. The relationships between and among the objects in the object set are defined by the object hierarchy and entity relation graphs. The video description records provide a standard vehicle for describing the content and context of video information for subsequent access and processing by computer applications such as search engines, filters, and archive systems.

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VIDEO DESCRIPTION SYSTEM AND METHOD

SPECIFICATION

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority to United States provisional patent application Serial No. 60/118,020, filed February 1, 1999, United States provisional patent application serial no. 60/118,027, filed February 1, 1999 and United States provisional patent application serial no. 60/107,463, filed November 6, 1998.

FIELD OF THE INVENTION

The present invention relates to techniques for describing multimedia information, and more specifically, to techniques which describe video information and the content of such information.

BACKGROUND OF THE INVENTION

With the maturation of the global Internet and the widespread employment of regional networks and local networks, digital multimedia information has become increasingly accessible to consumers and businesses. Accordingly, it has become progressively more important to develop systems that process, filter, search and organize digital multimedia information, so that useful information can be culled from this growing mass of raw information.

At the time of filing the instant application, solutions exist that allow consumers and business to search for textual information. Indeed, numerous text-based search engines, such as those provided by yahoo.com, goto.com, excite.com and others are available on the World Wide Web, and are among the most visited Web sites, indicating the significant of the demand for such information retrieval technology.

Unfortunately, the same is not true for multimedia content, as no generally recognized description of this material exists. In this regard, there have

been past attempts to provide multimedia databases which permit users to search for pictures using characteristics such as color, texture and shape information of video objects embedded in the picture. However, at the closing of the 20th Century, it is not yet possible to perform a general search the Internet or most regional or local networks for multimedia content, as no broadly recognized description of this material exists. Moreover, the need to search for multimedia content is not limited to databases, but extends to other applications, such as digital broadcast television and multimedia telephony.

One industry wide attempt to develop a standard multimedia description framework has been through the Motion Pictures Expert Group's ("MPEG") MPEG-7 standardization effort. Launched in October 1996, MPEG-7 aims to standardize content descriptions of multimedia data in order to facilitate content-focused applications like multimedia searching, filtering, browsing and summarization. A more complete description of the objectives of the MPEG-7 standard are contained in the International Organisation for Standardisation document ISO/IEC JTC1/SC29/WG11 N2460 (Oct. 1998), the content of which is incorporated by reference herein.

The MPEG-7 standard has the objective of specifying a standard set of descriptors as well as structures (referred to as "description schemes") for the descriptors and their relationships to describe various types of multimedia information. MPEG-7 also proposes to standardize ways to define other descriptors as well as "description schemes" for the descriptors and their relationships. This description, i.e. the combination of descriptors and description schemes, shall be associated with the content itself, to allow fast and efficient searching and filtering for material of a user's interest. MPEG-7 also proposes to standardize a language to specify description schemes, i.e. a Description Definition Language ("DDL"), and the schemes for binary encoding the descriptions of multimedia content.

At the time of filing the instant application, MPEG is soliciting proposals for techniques which will optimally implement the necessary description schemes for future integration into the MPEG-7 standard. In order to provide such optimized description schemes, three different multimedia-application arrangements

can be considered. These are the distributed processing scenario, the content-exchange scenario, and the format which permits the personalized viewing of multimedia content.

Regarding distributed processing, a description scheme must provide the ability to interchange descriptions of multimedia material independently of any platform, any vendor, and any application, which will enable the distributed processing of multimedia content. The standardization of interoperable content descriptions will mean that data from a variety of sources can be plugged into a variety of distributed applications, such as multimedia processors, editors, retrieval systems, filtering agents, etc . Some of these applications may be provided by third parties, generating a sub-industry of providers of multimedia tools that can work with the standardized descriptions of the multimedia data.

A user should be permitted to access various content providers' web sites to download content and associated indexing data, obtained by some low-level or high-level processing, and proceed to access several tool providers' web sites to download tools (e.g. Java applets) to manipulate the heterogeneous data descriptions in particular ways, according to the user's personal interests. An example of such a multimedia tool will be a video editor. A MPEG-7 compliant video editor will be able to manipulate and process video content from a variety of sources if the description associated with each video is MPEG-7 compliant. Each video may come with varying degrees of description detail, such as camera motion, scene cuts, annotations, and object segmentations.

A second scenario that will greatly benefit from an interoperable content-description standard is the exchange of multimedia content among heterogeneous multimedia databases. MPEG-7 aims to provide the means to express, exchange, translate, and reuse existing descriptions of multimedia material.

Currently, TV broadcasters, Radio broadcasters, and other content providers manage and store an enormous amount of multimedia material. This material is currently described manually using textual information and proprietary databases. Without an interoperable content description, content users need to invest manpower to translate manually the descriptions used by each broadcaster into their

own proprietary scheme. Interchange of multimedia content descriptions would be possible if all the content providers embraced the same content description schemes. This is one of the objectives of MPEG-7.

Finally, multimedia players and viewers that employ the description schemes must provide the users with innovative capabilities such as multiple views of the data configured by the user. The user should be able to change the display's configuration without requiring the data to be downloaded again in a different format from the content broadcaster.

The foregoing examples only hint at the possible uses for richly structured data delivered in a standardized way based on MPEG-7. Unfortunately, no prior art techniques available at present are able to generically satisfy the distributed processing, content-exchange, or personalized viewing scenarios. Specifically, the prior art fails to provide a technique for capturing content embedded in multimedia information based on either generic characteristics or semantic relationships, or to provide a technique for organizing such content. Accordingly, there exists a need in the art for efficient content description schemes for generic multimedia information.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a description scheme for video content.

It is a further object of the present invention to provide a description scheme for video content which is extensible.

It is another object of the present invention to provide a description scheme for video content which is scalable.

It is yet another object of the present invention to provide a description scheme for video content which satisfies the requirements of proposed media standards, such as MPEG-7.

It is an object of the present invention to provide systems and methods for describing video content.

It is a further object of the present invention to provide systems and methods for describing video content which are extensible.

It is another object of the present invention to provide systems and method for describing video content which are scalable.

It is yet another object of the present invention to provide systems and methods for describing video content which satisfies the requirements of proposed media standards, such as MPEG-7

In accordance with the present invention, a first method of describing video content in a computer database record includes the steps of establishing a plurality of objects in the video; characterizing the objects with a plurality of features of the objects; and relating the objects in a hierarchy in accordance with the features. The method can also include the further the step of relating the objects in accordance with at least one entity relation graph.

Preferably, the objects can take the form of local objects (such as a group of pixels within a frame), segment objects (which represent one or more frames of a video clip) and global objects. The objects can be extracted from the video content automatically, semi-automatically, or manually.

The features used to define the video objects can include visual features, semantic features, media features, and temporal features. A further step in the method can include assigning feature descriptors to further define the features.

In accordance with another embodiment of the invention, computer readable media is programmed with at least one video description record describing video content. The video description record, which is preferably formed in accordance with the methods described above, generally includes a plurality of objects in the video; a plurality of features characterizing said objects; and a hierarchy relating at least a portion of the video objects in accordance with said features.

Preferably, the description record for a video clip further includes at least one entity relation graph. It is also preferred that the features include at least one of visual features, semantic features, media features, and temporal features. Generally, the features in the description record can be further defined with at least on feature descriptor.

A system for describing video content and generating a video description record in accordance with the present invention includes a processor, a video input

interface operably coupled to the processor for receiving the video content, a video display operatively coupled to the processor; and a computer accessible data storage system operatively coupled to the processor. The processor is programmed to generate a video description record of the video content for storage in the computer accessible data storage system by performing video object extraction processing, entity relation graph processing, and object hierarchy processing of the video content.

In this exemplary system, video object extraction processing can include video object extraction processing operations and video object feature extraction processing operations.

BRIEF DESCRIPTION OF THE DRAWING

Further objects, features and advantages of the invention will become apparent from the following detailed description taken in conjunction with the accompanying figures showing illustrative embodiments of the invention, in which

Figure 1A is an exemplary image for the image description system of the present invention.

Figure 1B is an exemplary object hierarchy for the image description system of the present invention.

Figure 1C is an exemplary entity relation graph for the image description system of the present invention.

Figure 2 is an exemplary block diagram of the image description system of the present invention.

Figure 3A is an exemplary object hierarchy for the image description system of the present invention.

Figure 3B is another exemplary object hierarchy for the image description system of the present invention.

Figure 4A is a representation of an exemplary image for the image description system of the present invention.

Figure 4B is an exemplary clustering hierarchy for the image description system of the present invention.

Figure 5 is an exemplary block diagram of the image description system of the present invention.

Figure 6 is an exemplary process flow diagram for the image description system of the present invention.

Figure 7 is an exemplary block diagram of the image description system of the present invention.

Figure 8 is an another exemplary block diagram of the image description system of the present invention.

Figure 9 is a schematic diagram of a video description scheme (DS), in accordance with the present invention.

Figure 10 is a pictorial diagram of an exemplary video clip, with a plurality of objects defined therein.

Figure 11 is a graphical representation of an exemplary semantic hierarchy illustrating exemplary relationships among objects in the video clip of Figure 10.

Figure 12 is a graphical representation of an entity relation graph illustrating exemplary relationships among objects in the video clip of Figure 10.

Figure 13 is a block diagram of a system for creating video content descriptions in accordance with the present invention.

Figure 14 is a flow diagram illustrating the processing operations involved in creating video content description records in accordance with the present invention.

Throughout the figures, the same reference numerals and characters, unless otherwise stated, are used to denote like features, elements, components or portions of the illustrated embodiments. Moreover, while the subject invention will now be described in detail with reference to the figures, it is done so in connection with the illustrative embodiments. It is intended that changes and modifications can be made to the described embodiments without departing from the true scope and spirit of the subject invention as defined by the appended claims.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention constitutes a description scheme (DS) for images, wherein simple but powerful structures representing generic image data are utilized. Although the description scheme of the present invention can be used with any type of standard which describes image content, a preferred embodiment of the invention is used with the MPEG-7 standard. Although any Description Definition Language (DDL) may be used to implement the DS of the present invention, a preferred embodiment utilizes the eXtensible Markup Language (XML), which is a streamlined subset of SGML (Standard Generalized Markup Language, ISO 8879) developed specifically for World Wide Web applications. SGML allows documents to be self-describing, in the sense that they describe their own grammar by specifying the tag set used in the document and the structural relationships that those tags represent. XML retains the key SGML advantages in a language that is designed to be vastly easier to learn, use, and implement than full SGML. A complete description of XML can be found at the World Wide Web Consortium's web page on XML, at http://www.w3.org/XML/, the contents of which is incorporated by reference herein.

The primary components of a characterization of an image using the description scheme of the present invention are objects, feature classifications, object hierarchies, entity-relation graphs, multiple levels of abstraction, code downloading, and modality transcoding, all of which will be described in additional detail below. In the description scheme of the present invention, an image document is represented by a set of objects and relationships among objects. Each object may have one or more associated features, which are generally grouped into the following categories: media features, visual features, and semantic features. Each feature can include descriptors that can facilitate code downloading by pointing to external extraction and similarity matching code. Relationships among objects can be described by object hierarchies and entity-relation graphs. Object hierarchies can also include the concept of multiple levels of abstraction. Modality transcoding allows user terminals having different capabilities (such as palmpilots, cellular telephones, or different types of personal

computers (PC's), for example) to receive the same image content in different resolutions and/or different modalities.

As described above, a preferred embodiment of the image description system of the present invention is used with the MPEG-7 standard. In accord with this standard, this preferred embodiment uses objects as the fundamental entity in describing various levels of image content, which can be defined along different dimensions. For example, objects can be used to describe image regions or groups of image regions. High-level objects can in turn be used to describe groups of primitive objects based on semantics or visual features. In addition, different types of features can be used in connection with different levels of objects. For instance, visual features can be applied to objects corresponding to physical components in the image content, whereas semantic features can be applied to any level of object.

In addition, the image description system of the present invention provides flexibility, extensibility, scalability and convenience of use. In the interest of enhanced flexibility, the present invention allows portions of the image description system to be instantiated, uses efficient categorization of features and clustering of objects by way of an clustering hierarchy, and also supports efficient linking, embedding and downloading of external feature descriptors and execution code. The present invention also provides extensibility by permitting elements defined in the description scheme to be used to derive new elements for different domains. Scalability is provided by the present invention's capability to define multiple abstraction levels based on any arbitrary set of criteria using object hierarchies. These criteria can be specified in terms of visual features (size and color, for example), semantic relevance (relevance to user interest profile, for example) and/or service quality (media features, for example). The present invention is convenient to use because it specifies a minimal set of components: namely, objects, feature classes, object hierarchies, and entity-relation graphs. Additional objects and features can be added in a modular and flexible way. In addition, different types of object hierarchies and entity-relation graphs can each be defined in a similar fashion.

Under the image description system of the present invention, an image is represented as a set of image objects, which are related to one another by object

hierarchies and entity-relation graphs. These objects can have multiple features which can be linked to external extraction and similarity matching code. These features are categorized into media, visual, and semantic features, for example. Image objects can be organized in multiple different object hierarchies. Non-hierarchical relationships among two or more objects can be described using one or more different entity-relation graphs. For objects contained in large images, multiple levels of abstraction in clustering and viewing such objects can be implemented using object hierarchies. These multiple levels of abstraction in clustering and viewing such images can be based on media, visual, and/or semantic features, for example. One example of a media feature includes modality transcoding, which permits users having different terminal specifications to access the same image content in satisfactory modalities and resolutions.

The characteristics and operation of the image description system of the present invention will now be presented in additional detail. Figs. 1A, 1B and 1C depict an exemplary description of an exemplary image in accordance with the image description system of the present invention. Fig. 1A depicts an exemplary set of image objects and exemplary corresponding object features for those objects. More specifically, Fig. 1A depicts image object 1 (i.e., O1) 2 ("Person A"), O2 6 ("Person B") and O3 4 ("People") contained in O0 8 (i.e., the overall exemplary photograph), as well as exemplary features 10 for the exemplary photograph depicted. Fig. 1B depicts an exemplary spatial object hierarchy for the image objects depicted in Fig. 1A, wherein O0 8 (the overall photograph) is shown to contain O1 2 ("Person A") and O2 6 ("Person B"). Fig. 1C depicts an exemplary entity-relation (E-R) graph for the image objects depicted in Fig. 1A, wherein O1 2 ("Person A") is characterized as being located to the left of, and shaking hands with, O2 6 ("Person B").

Fig. 2 depicts an exemplary graphical representation of the image description system of the present invention, utilizing the conventional Unified Modeling Language (UML) format and notation. Specifically, the diamond-shaped symbols depicted in Fig. 2 represent the composition relationship. The range associated with each element represents the frequency in that composition

relationship. Specifically, the nomenclature "0...*" denotes "greater than or equal to 0;" the nomenclature "1...*" denotes "greater than or equal to 1."

In the following discussion, the text appearing between the characters "<" and ">" denotes the characterization of the referenced elements in the XML preferred embodiments which appear below. In the image description system of the present invention as depicted in Fig. 2, an image element 22 (<image>), which represents an image description, includes an image object set element 24 (<image_object_set>), and may also include one or more object hierarchy elements 26 (<object_hierarchy>) and one or more entity-relation graphs 28 (<entity_relation_graph>). Each image object set element 24 includes one or more image object elements 30. Each image object element 30 may include one or more features, such as media feature elements 36, visual feature elements 38 and/or semantic feature elements 40. Each object hierarchy element 26 contains an object node element 32, each of which may in turn contain one or more additional object node elements 32. Each entity-relation graph 28 contains one or more entity relation elements 34. Each entity relation element 34 in turn contains a relation element 44, and may also contain one or more entity node elements 42.

An object hierarchy element 26 is a special case of an entity-relation graph 28, wherein the entities are related by containment relationships. The preferred embodiment of the image description system of the present invention includes object hierarchy elements 26 in addition to entity relationship graphs 28, because an object hierarchy element 26 is a more efficient structure for retrieval than is an entity relationship graph 28. In addition, an object hierarchy element 26 is the most natural way of defining composite objects, and MPEG-4 objects are constructed using hierarchical structures.

To maximize flexibility and generality, the image description system of the present invention separates the definition of the objects from the structures that describe relationships among the objects. Thus, the same object may appear in different object hierarchies 26 and entity-relation graphs 28. This avoids the undesirable duplication of features for objects that appear in more than one object hierarchy 26 and/or entity-relation graph 28. In addition, an object can be defined

without the need for it to be included in any relational structure, such as an object hierarchy 26 or entity-relation graph 28, so that the extraction of objects and relations among objects can be performed at different stages, thereby permitting distributed processing of the image content.

Referring to Figs. 1A, 1B, 1C and Fig. 2, an image object 30 refers to one or more arbitrary regions of an image, and therefore can be either continuous or discontinuous in space. In Figs. 1A, 1B and 1C, O1 2 ("Person A"), O2 6 ("Person B"), and O0 8 (i.e., the photograph) are objects with only one associated continuous region. On the other hand, O3 4 ("People") is an example of an object composed of multiple regions separated from one another in space. A global object contains features that are common to an entire image, whereas a local object contains only features of a particular section of that image. Thus, in Figs. 1A, 1B and 1C, O0 8 is a global object representing the entire image depicted, whereas O1 2, O2 4 and O3 4 are each local objects representing a person or persons contained within the overall image.

Various types of objects which can be used in connection with the present invention include visual objects, which are objects defined by visual features such as color or texture; media objects; semantic objects; and objects defined by a combination of semantic, visual, and media features. Thus, an object's type is determined by the features used to describe that object. As a result, new types of objects can be added as necessary. In addition, different types of objects may be derived from these generic objects by utilizing inheritance relationships, which are supported by the MPEG-7 standard.

As depicted in Fig. 2, the set of all image object elements 30 (<image_object>) described in an image is contained within the image object set element 24 (<image_object_set>). Each image object element 30 can have a unique identifier within an image description. The identifier and the object type (e.g., local or global) are expressed as attributes of the object element ID and type, respectively. An exemplary implementation of an exemplary set of objects to describe the image depicted in Figs. 1A, 1B and 1C is shown below listed in XML. In all XML listings

shown below, the text appearing between the characters "<!–" and "–>" denotes comments to the XML code:

```
<image_object_set>
        <image_object id="O0" type="GLOBAL"> </image_object> <!– Photograph –>
        <image_object id="O1" type="LOCAL"> </image_object> <!– Person A –>
        <image_object id="O2" type="LOCAL"> </image_object> <!– Person B –>
        <image_object id="O3" type="LOCAL"> </image_object> <!– People –>
</image_object_set>
```

As depicted in Fig. 2. image objects 30 may for example contain three feature class elements that group features together according to the information conveyed by those features. Examples of such feature class elements include media features 36 (<img_obj_media_features>). visual features 38 (<img_obj_visual_features>), and semantic features 40 (<img_obj_media_ features>). Table 1 below denotes an exemplary list of features for each of these feature classes.

Table 1: Exemplary Feature Classes and Features.

Feature Class	Features
Semantic	Text Annotation. Who. What Object. What Action, Why, When, Where
Visual	Color. Texture. Position. Size. Shape. Orientation
Media	File Format. File Size. Color Representation, Resolution, Data File Location. Modality Transcoding, Author, Date of Creation

Each feature element contained in the feature classes in an image object element 30 will include descriptors in accordance with the MPEG-7 standard. Table 2 below denotes exemplary descriptors that may be associated with certain of

the exemplary visual features denoted in Table 1. Specific descriptors such as those denoted in Table 2 may also contain links to external extraction and similarity matching code. Although Tables 1 and 2 denote exemplary features and descriptors, the image description system of the present invention may include, in an extensible and modular fashion, any number of features and descriptors for each object.

Table 2: Exemplary Visual Features and Associated Descriptors.

Feature	Descriptors
Color	Color Histogram, Dominant Color, Color Coherence Vector, Visual Sprite Color
Texture	Tamura, MSAR, Edge Direction Histogram, DCT Coefficient Energies, Visual Sprite Texture
Shape	Bounding Box, Binary Mask, Chroma Key, Polygon Shape, Fourier Shape, Boundary, Size, Symmetry, Orientation

The XML example shown below denotes an example of how features and descriptors can be defined to be included in an image object 30. In particular, the below example defines the exemplary features 10 associated with the global object O0 depicted in Figs. 1A, 1B and 1C, namely, two semantic features ("where" and "when"), one media feature ("file format"), and one visual feature ("color" with a "color histogram" descriptor). An object can be described by different concepts (<concept>) in each of the semantic categories as shown in the example below.

```
<image_object id="O0" type="GLOBAL"> <!-- Global object: Photograph -->
        <img_obj_semantic_features>
                <where>
                        <concept> Columbia University, NYC </concept>
```

```
                    <concept> Outdoors </concept>
                </where>
                <when> <concept> 5/31/99 </concept> </when>
            </img_obj_semantic_features>
            <img_obj_media_features>
                <file_format> JPG </file_format>
            </img_obj_media_features>
            <img_obj_visual_features>
                <color>
                    <color_histogram>
                        <value format="float[166]"> .3 .03 .45 ... </value>
                    </color_histogram>
                </color>
            </img_obj_visual_features>
        </image_global_object>
```

As depicted in Fig. 2, in the image description system of the present invention the object hierarchy element 26 can be used to organize the image objects 30 in the image object set 24, based on different criteria such as media features 36, visual features 38, semantic features 40, or any combinations thereof. Each object hierarchy element 26 constitutes a tree of object nodes 32 which reference image object elements 30 in the image object set 24 via link 33.

An object hierarchy 26 involves a containment relation from one or more child nodes to a parent node. This containment relation may be of numerous different types, depending on the particular object features being utilized, such as media features 36, visual features 38 and/or semantic features 40, for example. For example, the spatial object hierarchy depicted in Fig. 1B describes a visual containment, because it is created in connection with a visual feature, namely spatial position. Figs. 3A and 3B depict two additional exemplary object hierarchies. Specifically, Fig. 3A depicts an exemplary hierarchy for the image objects depicted in Fig. 1A, based on the "who" semantic feature as denoted in Table 1. Thus, in Fig. 3A, O3 4 ("People") is shown to contain O1 2 ("Person A") and O2 6 ("Person B"). Fig. 3B depicts an exemplary hierarchy based on exemplary color and shape visual features such as those denoted in Table 1. In Fig. 3B, O7 46 could for example be

defined to be the corresponding region of an object satisfying certain specified color and shape constraints. Thus, Fig. 3B depicts O7 46 ("Skin Tone & Shape") as containing O4 48 ("Face Region 1") and O6 50 ("Face Region 2"). Object hierarchies 26 combining different features can also be constructed to satisfy the requirements of a broad range of application systems.

As further depicted in Fig. 2, each object hierarchy element 26 (<object_hierarchy>) contains a tree of object nodes (ONs) 32. The object hierarchies also may include optional string attribute types. If such string attribute types are present, a thesaurus can provide the values of these string attribute types so that applications can determine the types of hierarchies which exist. Every object node 32 (<object_node>) references an image object 30 in the image object set 24 via link 33. Image objects 30 also can reference back to the object nodes 32 referencing them via link 33. This bi-directional linking mechanism permits efficient transversal from image objects 30 in the image object set 24 to the corresponding object nodes 32 in the object hierarchy 26, and vice versa. Each object node 32 references an image object 30 through an attribute (object_ref) by using a unique identifier of the image object. Each object node 32 may also contain a unique identifier in the form of an attribute. These unique identifiers for the object nodes 32 enable the objects 30 to reference back to the object nodes which reference them using another attribute (object_node_ref). An exemplary XML implementation of the exemplary spatial object hierarchy depicted in Fig. 1B is expressed below.

```
<object_hierarchy type="SPATIAL"> <!-- Object hierarchy: spatial hierarchy -->
        <object_node id="ON0" object_ref ="O0"> <!- Photograph -->
                <object_node id="ON1" object_ref="O1"> </object_node> <!-- Person A -->
                <object_node id="ON2" object_ref="O2"> </object_node> <!-- Person B -->
        </object_node>
</object_hierarchy>
```

Object hierarchies 26 can also be used to build clustering hierarchies and to generate multiple levels of abstraction. In describing relatively large images, such as satellite photograph images for example, a problem normally arises in

describing and retrieving, in an efficient and scalable manner, the many objects normally contained in such images. Clustering hierarchies can be used in connection with the image description system of the present invention to provide a solution to this problem.

Figs. 4A and 4B depict an exemplary use of an clustering hierarchy scheme wherein objects are clustered hierarchically based on their respective size (<size>). In particular, Fig. 4A depicts a representation of a relatively large image, such as a satellite photograph image for example, wherein objects O11 52, O12 54, O13 56, O14 58 and O15 60 represent image objects of varying size, such as lakes on the earth's surface for example, contained in the large image. Fig. 4B represents an exemplary size-based clustering hierarchy for the objects depicted in Fig. 4A, wherein objects O11 52, O12 54, O13 56, O14 58 and O15 60 represent the objects depicted in Fig. 4A, and wherein additional objects O16 62, O17 64 and O18 56 represent objects which specify the size-based criteria for the cluster hierarchy depicted in Fig. 4B. In particular, objects O16 62, O17 64 and O18 56 may for example represent intermediate nodes 32 of an object hierarchy 26, which intermediate nodes are represented as image objects 30. These objects include the criteria, conditions and constraints related to the size feature used for grouping the objects together in the depicted cluster hierarchy. In the particular example depicted in Fig. 4B, objects O16 62, O17 64 and O18 56 are used to form an clustering hierarchy having three hierarchal levels based on size. Object O16 62 represents the size criteria which forms the clustering hierarchy. Object O17 64 represents a second level of size criteria of less than 50 units, wherein such units may represent pixels for example; object O18 56 represents a third level of size criteria of less than 10 units. Thus, as depicted in Fig. 4B, objects O11 52, O12 54, O13 56, O14 58 and O15 60 are each characterized as having a specified size of a certain number of units. Similarly, objects O13 56, O14 58 and O15 60 are each characterized as having a specified size of less than 50 units, and object O15 60 is characterized as having a specified size of less than 10 units.

Although Figs. 4A and 4B depict an example of a single clustering hierarchy based on only a single set of criteria, namely size, multiple clustering

hierarchies using different criteria involving multiple features may also be used for any image. For example, such clustering hierarchies may group together objects based on any combination of media, visual, and/or semantic features. This procedure is similar to the procedure used to cluster images together in visual information retrieval engines. Each object contained within the overall large image is assigned an image object 30 in the object set 24, and may also be assigned certain associated features such as media features 36, visual features 38 or semantic features 40. The intermediate nodes 32 of the object hierarchy 26 are represented as image objects 30, and also include the criteria, conditions and constraints related to one or more features used for grouping the objects together at that particular level. An image description may include any number of clustering hierarchies. The exemplary clustering hierarchy depicted in Figs. 4A and 4B is expressed in an exemplary XML implementation below.

```
<image>
    <image_object_set>
        <image_object type="LOCAL" id="O11"> <!-- Real objects of the image -->
            <size> <num_pixels> 120 </num_pixels> </size>
        </image_object> <!-- Others objects -->
        <image_object type="LOCAL" id="O17"> <!--Intermediate nodes in the
hierarchy-->
            <size> <num_pixels> <less_than> 50 </less_than> </num_pixels>
</size>
        </image_object> <!-- Others objects -->
    </image_object_set>
    <object_hierarchy>
        <object_node id="ON11" object_ref="O16">
            <object_node id="ON12" object_ref="O11" />
            <object_node id="ON13" object_ref="O12" />
            <object_node id="ON14" object_ref="O17">
                <object_node id="ON15" object_ref="O13" />
                <object_node id="ON16" object_ref="O14" />
                <object_node id="ON17" object_ref="O18">
                    <object_node id="ON18" object_ref="O15" />
                </object_node>
            </object_node>
        </object_node>
```

</object_hierarchy>
</image>.

As depicted in the multiple clustering hierarchy example of Figs. 4A and 4B, and as denoted in Table 3 below, there are defined three levels of abstraction based on the size of the objects depicted. This multi-level abstraction scheme provides a scalable method for retrieving and viewing objects in the image depicted in Fig. 4A. Such an approach can also be used to represent multiple abstraction levels based on other features, such as various semantic classes for example.

Table 3: Objects in Each Abstraction Level

Abstraction Level	Objects
1	O11, O12
2	O11, O12, O13, O14
3	O11, O12, O13, O14, O15

Although such hierarchical structures are suitable for purposes of retrieving images, certain relationships among objects cannot adequately be expressed using such structures. Thus, as depicted in Figs. 1C and 2, the image description system of the present invention also utilizes entity-relation (E-R) graphs 28 for the specification of more complex relationships among objects. An entity-relation graph 28 is a graph of one or more entity nodes 42 and the relationships among them. Table 4 below denotes several different exemplary types of such relationships, as well as specific examples of each.

Table 4: Examples of relation types and relations.

Relation Type		Relations
Spatial		
	Directional	Top Of, Bottom Of, Right Of, Left Of, Upper Left Of, Upper Right Of, Lower Left Of, Lower Right Of
	Topological	Adjacent To, Neighboring To, Nearby, Within, Contain
Semantic		Relative Of, Belongs To, Part Of, Related To, Same As, Is A, Consist Of

Entity-relation graphs can be of any general structure, and can also be customized for any particular application by utilizing various inheritance relationships. The exemplary entity-relation graph depicted in Fig. 1C describes an exemplary spatial relationship, namely "Left Of", and an exemplary semantic relationship, namely "Shaking Hands With", between objects O1 2 and O2 6 depicted in Fig. 1A.

As depicted in Fig. 2, the image description system of the present invention allows for the specification of zero or more entity-relation graphs 28 (<entity_relation_ graph>). An entity-relation graph 28 includes one or more sets of entity-relation elements 34 (<entity_relation >), and also contains two optional attributes, namely a unique identifier ID and a string type to describe the binding expressed by the entity relation graph 28. Values for such types could for example be provided by a thesaurus. Each entity relation element 34 contains one relation element 44 (<relation>), and may also contain one or more entity node elements 42 (<entity_node>) and one or more entity-relation elements 34. The relation element 44 contains the specific relationship being described. Each entity node element 42 references an image object 30 in the image object set 24 via link 43, by utilizing an

attribute, namely object_ref. Via link 43, image objects 30 also can reference back to the entity nodes 42 referencing the image objects 30 by utilizing an attribute (event_code_refs).

As depicted in the exemplary entity-relation graph 28 of Fig. 1C, the entity-relation graph 28 contains two entity relations 34 between object O1 2 ("Person A") and object O2 6 ("Person B"). The first such entity relation 34 describes the spatial relation 44 regarding how object O1 2 is positioned with respect to (i.e., to the "Left Of") object O2 6. The second such entity relation 34 depicted in Fig. 1C describes the semantic relation 44 of how object O1 2 is "Shaking Hand With" object O2 6. An exemplary XML implementation of the entity-relation graph example depicted in Fig. 1C is shown below:

```
<entity_relation_graph>
    <entity_relation> <!- Spatial. directional entity relation –>
        <relation type="SPATIAL.DIRECTIONAL"> Left Of </relation>
        <entity_node id="ETN1" object_ref="O1"/> <entity_node id="ETN2" object_ref="O2"/>
    </entity_relation>
    <entity_relation> <!- Semantic entity relation –>
        <relation type="SEMANTIC"> Shaking hands with </relation>
        <entity_node id="ETN3" object_ref="O2"/> <entity_node id="ETN4"
object_ref="O1"/>
    </entity_relation>
</entity_relation_graph>
```

For purposes of efficiency, entity-relation elements 34 may also include one or more other entity-relation elements 34, as depicted in Fig. 2. This allows the creation of efficient nested graphs of entity relationships, such as those utilized in the Synchronized Multimedia Integration Language (SMIL), which synchronizes different media documents by using a series of nested parallel sequential relationships.

An object hierarchy 26 is a particular type of entity-relation graph 28 and therefore can be implemented using an entity-relation graph 28, wherein entities are related by containment relationships. Containment relationships are topological

relationships such as those denoted in Table 4. To illustrate that an object hierarchy 26 is a particular type of an entity-relation graph 28, the exemplary object hierarchy 26 depicted in Fig. 1B is expressed below in XML as an entity-relation graph 28.

```
<entity_relation_graph>
    <entity_relation>
        <relation type="SPATIAL"> Contain </relation>
        <entity_node object_ref="O0"/> <entity_node object_ref="O1"/>
    </entity_relation>
    <entity_relation>
        <relation type="SPATIAL"> Contain </relation>
        <entity_node object_ref="O0"/> <entity_node object_ref="O2"/>
    </entity_relation>
</entity_relation_graph>
```

The exemplary hierarchy depicted in Fig. 1B describes how object O0 8 (the overall photograph) spatially contains objects O1 2 ("Person A") and O2 6 ("Person B"). Thus, based on particular requirements, applications may implement hierarchies utilizing either the convenience of the comprehensive structure of an entity-relation graph 28, or alternatively by utilizing the efficiency of object hierarchies 26.

For image descriptors associated with any type of features, such as media features 36, visual features 38 or semantic features 40 for example, the image description system of the present invention may also contain links to extraction and similarity matching code in order to facilitate code downloading, as illustrated in the XML example below. These links provide a mechanism for efficient searching and filtering of image content from different sources using proprietary descriptors. Each image descriptor in the image description system of the present invention may include a descriptor value and a code element, which contain information regarding the extraction and similarity matching code for that particular descriptor. The code elements (<code>) may also include pointers to the executable files (<location>), as well as the description of the input parameters (<input_parameters>) and output parameters (<output_parameters>) for executing the code. Information about the type of code (namely, extraction code or similarity matching code), the code language

(such as Java or C for example), and the code version are defined as particular attributes of the code element.

The exemplary XML implementation set forth below provides a description of a so-called Tamura texture feature, as set forth in H. Tamura, S. Mori, and T. Yamawaki, "Textual Features Corresponding to Visual Perception," IEEE Transactions on Systems, Man and Cybernetics, Vol. 8, No. 6, June 1978, the entire content of which is incorporated herein by reference. The Tamura texture feature provides the specific feature values (namely, coarseness, contrast, and directionality) and also links to external code for feature extraction and similarity matching. In the feature extraction example shown below, additional information about input and output parameters is also provided. Such a description could for example be generated by a search engine in response to a texture query from a meta search engine. The meta search engine could then use the code to extract the same feature descriptor from the results received from other search engines, in order to generate a homogeneous list of results for a user. In other cases, only the extraction and similarity matching code, but not the specific feature values, is included. If necessary in such instances, filtering agents may be used to extract feature values for processing.

The exemplary XML implementation shown below also illustrates the way in which the XML language enables externally defined description schemes for descriptors to be imported and combined into the image description system of the present invention. In the below example, an external descriptor for the Croma Key shape feature is imported into the image description by using XML namespaces. Using this framework, new features, types of features, and image descriptors can be conveniently included in an extensible and modular way.

```
<texture> <tamura>
        <tamura_value coarseness="0.01" contrast="0.39" directionality="0.7"/>
        <code type="EXTRACTION" language="JAVA" version="1.1"> <!-- Link extraction
code -->
                <location> <location_site href="ftp://extract.tamura.java"/> </location>
                <input_parameters> <parameter name="image" type="PPM"/>
</input_parameters>
                <output_parameters>
```

```
                    <parameter name="tamura texture" type="double[3]"/>
                </output_parameters>
            </code>
            <code type="DISTANCE" language="JAVA" version="4.2"> <!-- Link similarity code --
>
                <location> <location_site href="ftp://distance.tamura.java"/> </location>
            </code>
        </tamura> </texture>

        <shape> <!-- Import external shape descriptor DTD -->
            <chromaKeyShape xmlns:extShape "http://www.other.ds/chromaKeyShape.dtd">
                <extShape:HueRange>
                    <extShape:start> 40 </extShape:start> <extShape:end> 40
        </extShape:end>
                </extShape:HueRange>
            </chromaKeyShape>
        </shape>
```

The image description system of the present invention also supports modality transcoding. In an exemplary instance in which a content broadcaster must transmit image content to a variety of users, the broadcaster must transcode the image content into different media modalities and resolutions, in order to accommodate the users' various terminal requirements and bandwidth limitations. The image description system of the present invention provides modality transcoding in connection with both local and global objects. This modality transcoding transcodes the media modality, resolution, and location of transcoded versions of the image objects in question, or alternatively links to external transcoding code. The image descriptor in question also can point to code for transcoding an image object into different modalities and resolutions, in order to satisfy the requirements of different user terminals. The exemplary XML implementation shown below illustrates providing an audio transcoded version for an image object.

```
        <image_object type="GLOBAL" id="O0">
            <img_obj_media_features>
                <location> <location_site href="Hi.gif"/> </location>
                <modality_transcoding>
                    <modality_object_set>
```

```
                    <modality_object id="mo2" type="AUDIO" resolution="1">
                        <location><location_site
href="Hi.au.xml"?o1/></location>
                    </modality_object>
                <modality_object_set>
            </modality_transcoding>
<img_obj_media_features>
</image_object>
```

Fig. 5 depicts a block diagram of an exemplary computer system for implementing the image description system of the present invention. The computer system depicted includes a computer processor section 402 which receives digital data representing image content, via image input interface 404 for example. Alternatively, the digital image data can be transferred to the processor section 402 from a remote source via a bidirectional communications input/output (I/O) port 406. The image content can also be transferred to the processor section 402 from non-volatile computer media 408, such as any of the optical data storage or magnetic storage systems well known in the art. The processor section 402 provides data to an image display system 410, which generally includes appropriate interface circuitry and a high resolution monitor, such as a standard SVGA monitor and video card which are commonly employed in conventional personal computer systems and workstations for example. A user input device, such as a keyboard and digital pointing device a mouse, trackball, light pen or touch screen for example), is coupled to the processor section 402 to effect the user's interaction with the computer system. The exemplary computer system of Fig. 5 will also normally include volatile and non volatile computer memory 414, which can be accessed by the processor section 402 during processing operations.

Fig. 6 depicts a flow chart diagram which further illustrates the processing operations undertaken by the computer system depicted in Fig. 5 for purposes of implementing the image description system of the present invention. Digital image data 310 is applied to the computer system via link 311. The computer system, under the control of suitable application software, performs image object extraction in block 320, in which image objects 30 and associated features, such as

media features 36, visual features 38 and semantic features 40 for example, are generated. Image object extraction 320 may take the form of a fully automatic processing operation, a semi-automatic processing operation, or a substantially manual operation in which objects are defined primarily through user interaction, such as via user input device 412 for example.

In a preferred embodiment, image object extraction 320 consists of two subsidiary operations, namely image segmentation as depicted by block 325, and feature extraction and annotation as depicted by block 326. For the image segmentation 325 step, any region tracking technique which partitions digital images into regions that share one or more common characteristics may be employed. Likewise, for the feature extraction and annotation step 326, any technique which generates features from segmented regions may be employed. A region-based clustering and searching subsystem is suitable for automated image segmentation and feature extraction. An image object segmentation system is an example of a semi-automated image segmentation and feature extraction system. Manual segmentation and feature extraction could alternatively be employed. In an exemplary system, image segmentation 325 may for example generate image objects 30, and feature extraction and annotation 326 may for example generate the features associated with the image objects 30, such as media features 36, visual features 38 and semantic features 40, for example.

The object extraction processing 320 generates an image object set 24, which contains one or more image objects 30. The image objects 30 of the image object set 24 may then be provided via links 321, 322 and 324 for further processing in the form of object hierarchy construction and extraction processing as depicted in block 330, and/or entity relation graph generation processing as depicted in block 336. Preferably, object hierarchy construction and extraction 330 and entity relation graph generation 336 take place in parallel and via link 327. Alternatively, image objects 30 of the image object set 24 may be directed to bypass object hierarchy construction and extraction 330 and entity relation graph generation 336, via link 323. The object hierarchy construction and extraction 330 thus generates one or more object

hierarchies 26, and the entity relation graph generation 336 thus generates one or more entity relation graphs 28.

The processor section 402 then merges the image object set 24, object hierarchies 26 and entity relation graphs 28 into an image description record for the image content in question. The image description record may then be stored directly in database storage 340, or alternatively may first be subjected to compression by binary encoder 360 via links 342 and 361, or to encoding by description definition language encoding (using XML for example) by XML encoder 350 via links 341 and 351. Once the image description records have been stored in data base storage 340, they remain available in a useful format for access and use by other applications 370, such as search, filter and archiving applications for example, via bidirectional link 371.

Referring to Fig. 7, an exemplary embodiment of a client-server computer system on which the image description system of the present invention can be implemented is provided. The architecture of the system 100 includes a client computer 110 and a server computer 120. The server computer 120 includes a display interface 130, a query dispatcher 140, a performance database 150, query translators 160, 161, 165, target search engines 170, 171, 175, and multimedia content description systems 200, 201, 205, which will be described in further detail below.

While the following disclosure will make reference to this exemplary client-server embodiment, those skilled in the art should understand that the particular system arrangement may be modified within the scope of the invention to include numerous well-known local or distributed architectures. For example, all functionality of the client-server system could be included within a single computer, or a plurality of server computers could be utilized with shared or separated functionality.

Commercially available metasearch engines act as gateways linking users automatically and transparently to multiple text-based search engines. The system of Fig. 7 grows upon the architecture of such metasearch engines and is designed to intelligently select and interface with multiple on-line multimedia search engines by ranking their performance for different classes of user queries.

Accordingly, the query dispatcher 140, query translators 160, 161, 165, and display interface 130 of commercially available metasearch engines may be employed in the present invention.

The dispatcher 140 selects the target search engines to be queried by consulting the performance database 150 upon receiving a user query. This database 150 contains performance scores of past query successes and failures for each supported search option. The query dispatcher only selects search engines 170, 171, 175 that are able to satisfy the user's query, e.g. a query seeking color information will trigger color enabled search engines. Search engines 170, 171, 175 may for example be arranged in a client-server relationship, such as search engine 170 and associated client 172.

The query translators 160, 161, 165, translate the user query to suitable scripts conforming to the interfaces of the selected search engines. The display component 130 uses the performance scores to merge the results from each search engine, and presents them to the user.

In accordance with the present invention, in order to permit a user to intelligently search the Internet or a regional or local network for visual content, search queries may be made either by descriptions of multimedia content generated by the present invention, or by example or sketch. Each search engine 170, 171, 175 employs a description scheme, for example the description schemes described below, to describe the contents of multimedia information accessible by the search engine and to implement the search.

In order to implement a content-based search query for multimedia information, the dispatcher 140 will match the query description, through the multimedia content description system 200, employed by each search engine 170, 171, 175 to ensure the satisfaction of the user preferences in the query. It will then select the target search engines 170, 171, 175 to be queried by consulting the performance database 150. If for example the user wants to search by color and one search engine does not support any color descriptors, it will not be useful to query that particular search engine.

Next, the query translators 160, 161, 165 will adapt the query description to descriptions conforming to each selected search engine. This translation will also be based on the description schemes available from each search engine. This task may require executing extraction code for standard descriptors or downloaded extraction code from specific search engines to transform descriptors. For example, if the user specifies the color feature of an object using a color coherence of 166 bins, the query translator will translate it to the specific color descriptors used by each search engine, e.g. color coherence and color histogram of x bins.

Before displaying the results to the user, the query interface will merge the results from each search option by translating all the result descriptions into a homogeneous one for comparison and ranking. Again, similarity code for standard descriptors or downloaded similarity code from search engines may need to be executed. User preferences will determine how the results are displayed to the user.

Referring next to Fig. 8, a description system 200 which, in accordance with the present invention, is employed by each search engine 170, 171, 175 is now described. In the preferred embodiment disclosed herein, XML is used to describe multimedia content.

The description system 200 advantageously includes several multimedia processing, analysis and annotation sub-systems 210, 220, 230, 240, 250, 260, 270, 280 to generate a rich variety of descriptions for a collection of multimedia items 205. Each subsystem is described in turn.

The first subsystem 210 is a region-based clustering and searching system which extracts visual features such as color, texture, motion, shape, and size for automatically segmented regions of a video sequence. The system 210 decomposes video into separate shots by scene change detection, which may be either abrupt or transitional (e.g. dissolve, fade in/out, wipe). For each shot, the system 210 estimates both global motion (i.e. the motion of dominant background) and camera motion, and then segments, detects, and tracks regions across the frames in the shot computing different visual features for each region. For each shot, the description generated by this system is a set of regions with visual and motion features, and the camera motion. A complete description of the region-based clustering and searching

system 210 is contained in co-pending PCT Application Serial No. PCT/US98/09124, filed May 5, 1998, entitled "An Algorithm and System Architecture for Object-Oriented Content-Based Video Search," the contents of which are incorporated by reference herein.

As used herein, a "video clip" shall refer to a sequence of frames of video information having one or more video objects having identifiable attributes, such as, by way of example and not of limitation, a baseball player swinging a bat, a surfboard moving across the ocean, or a horse running across a prairie. A "video object" is a contiguous set of pixels that is homogeneous in one or more features of interest, e.g., texture, color, motion or shape. Thus, a video object is formed by one or more video regions which exhibit consistency in at least one feature. For example a shot of a person (the person is the "object" here) walking would be segmented into a collection of adjoining regions differing in criteria such as shape, color and texture, but all the regions may exhibit consistency in their motion attribute.

The second subsystem 220 is an MPEG domain face detection system, which efficiently and automatically detects faces directly in the MPEG compressed domain. The human face is an important subject in images and video. It is ubiquitous in news, documentaries, movies, etc., providing key information to the viewer for the understanding of the video content. This system provides a set of regions with face labels. A complete description of the system 220 is contained in PCT Application Serial No. PCT/US 97/20024, filed November 4, 1997, entitled "A Highly Efficient System for Automatic Face Region Detection in MPEG Video," the contents of which are incorporated by reference herein.

The third subsystem 230 is a video object segmentation system in which automatic segmentation is integrated with user input to track semantic objects in video sequences. For general video sources, the system allows users to define an approximate object boundary by using a tracing interface. Given the approximate object boundary, the system automatically refines the boundary and tracks the movement of the object in subsequent frames of the video. The system is robust enough to handle many real-world situations that are difficult to model using existing approaches, including complex objects, fast and intermittent motion, complicated

backgrounds, multiple moving objects and partial occlusion. The description generated by this system is a set of semantic objects with the associated regions and features that can be manually annotated with text. A complete description of the system 230 is contained in U.S. Patent Application Serial No. 09/405,555, filed September 24, 1998, entitled "An Active System and Algorithm for Semantic Video Object Segmentation," the contents of which are incorporated by reference herein.

The fourth subsystem 240 is a hierarchical video browsing system that parses compressed MPEG video streams to extract shot boundaries, moving objects, object features, and camera motion. It also generates a hierarchical shot-based browsing interface for intuitive visualization and editing of videos. A complete description of the system 240 is contained in PCT Application Serial No. PCT/US 97/08266, filed May 16, 1997, entitled "Efficient Query and Indexing Methods for Joint Spatial/Feature Based Image Search," the contents of which is incorporated by reference herein.

The fifth subsystem 250 is the entry of manual text annotations. It is often desirable to integrate visual features and textual features for scene classification. For images from on-line news sources, e.g. Clarinet, there is often textual information in the form of captions or articles associated with each image. This textual information can be included in the descriptions.

The sixth subsystem 260 is a system for high-level semantic classification of images and video shots based on low-level visual features. The core of the system consists of various machine learning techniques such as rule induction, clustering and nearest neighbor classification. The system is being used to classify images and video scenes into high level semantic scene classes such as {nature landscape}, {city/suburb}, {indoor}. and {outdoor}. The system focuses on machine learning techniques because we have found that the fixed set of rules that might work well with one corpus may not work well with another corpus, even for the same set of semantic scene classes. Since the core of the system is based on machine learning techniques, the system can be adapted to achieve high performance for different corpora by training the system with examples from each corpus. The description generated by this system is a set of text annotations to indicate the scene class for each

image or each keyframe associated with the shots of a video sequence. A complete description of the system 260 is contained in S. Paek et al., "Integration of Visual and Text based Approaches for the Content Labeling and Classification of Photographs," ACM SIGIR'99 Workshop on Multimedia Indexing and Retrieval. Berkeley, C A (1999), the contents of which are incorporated by reference herein.

The seventh subsystem 270 is model based image classification system. Many automatic image classification systems are based on a pre-defined set of classes in which class-specific algorithms are used to perform classification. The system 270 allows users to define their own classes and provide examples that are used to automatically learn visual models. The visual models are based on automatically segmented regions, their associated visual features, and their spatial relationships. For example, the user may build a visual model of a portrait in which one person wearing a blue suit is seated on a brown sofa, and a second person is standing to the right of the seated person. The system uses a combination of lazy-learning, decision trees and evolution programs during classification. The description generated by this system is a set of text annotations, i.e. the user defined classes, for each image. A complete description of the system 270 is contained in PCT Application Serial No. PCT/US 97/08266, filed May 16, 1997, entitled "A Method and Architecture for Indexing and Editing Compressed Video Over the World Wide Web," the contents of which are incorporated by reference herein.

Other subsystems 280 may be added to the multimedia content description system 200, such as a subsystems from collaborators used to generate descriptions or parts of descriptions, for example.

In operation, the image and video content 205 may be a database of still images or moving video, a buffer receiving content from a browser interface 206, or a receptacle for live image or video transmission. The subsystems 210, 220, 230, 240, 250, 260, 270, 280 operate on the image and video content 205 to generate descriptions 211, 221, 231, 241, 251, 261, 271, 281 that include low level visual features of automatically segmented regions, user defined semantic objects, high level scene properties, classifications and associated textual information, as described above. Once all the descriptions for an image or video item are generated and

integrated in block 290, the descriptions are then input into a database 295, which the search engine 170 accesses.

It should be noted that certain of the subsystems, i.e., the region-based clustering and searching subsystem 210 and the video object segmentation system 230 may implement the entire description generation process, while the remaining subsystems implement only portions of the process and may be called on by the subsystems 210, 230 during processing. In a similar manner, the subsystems 210 and 230 may be called on by each other for specific tasks in the process.

In Figures 1-6, systems and methods for describing image content are described. These techniques are readily extensible to video content as well. The performance of systems for searching and processing video content information can benefit from the creation and adoption of a standard by which such video content can be thoroughly and efficiently described. As used herein, the term "video clip" refers to an arbitrary duration of video content, such as a sequence of frames of video information. The term description scheme refers to the data structure or organization used to describe the video content. The term description record refers to the description scheme wherein the data fields of the data structure are defined by data which describes the content of a particular video clip.

Referring to Figure 9, an exemplary embodiment of the present video description scheme (DS) is illustrated in schematic form. The video DS inherits all of the elements of the image description scheme and adds temporal elements thereto, which are particular to video content. Thus, a video element 922 which represents a video description, generally includes a video object set 924, an object hierarchy definition 926 and entity relation graphs 928, all of which are similar to those described in connection with Figure 2. An exemplary video DS definition is illustrated below in Table 5.

Table 5: Elements in the Video Description Scheme (DS).

Element	Contains	May be Contained in
video	video_object_set (1) object_hierarchy[1] (0..*)	(root element)

	entity_relation_graph[1] (0..*)	
video_object_set	video_object (1..*)	video
video_object	vid_obj_media_features (0..1) vid_obj_semantic_features (0..1) vid_obj_visual_features (0..1) vid_obj_temporal_features (0..1)	object_set[1]
vid_obj_media_features	location[1] (0..1) file_format[1] (0..1) file_size[1] (0..1) resolution[1] (0..1) modality_transcoding[1] (0..1) bit_rate (0..1)	video_object
vid_obj_semantic_features	text_annotation[1] (0..1) who, what_object, what_action, when, where, why (0..1)	video_object
vid_obj_visual_features & type="LOCAL"	image_scl[1] (0..1) color[1] (0..1) texture[1] (0..1) shape[1] (0..1) size[1] (0..1) position[1] (0..1) motion (0..1)	video_object
vid_obj_visual_features & (type="SEGMENT" | type="GLOBAL")	video_scl (0..1) visual_sprite (0..1) transition (0..1) camera_motion (0..1) size(0..1) key_frame (0..*)	video_object
vid_obj_visual_features	time (0..1)	video_object
object_hierarchy[1]	object_node[1] (1)	video
object_node[1]	object_node[1] (0..*)	object_hierarchy[1] object_node[1]

entity_relation_graph[1]	entity_relation[1] (1..*)	Video
entity_relation[1]	relation[1] (1) entity_node[1] (1..*) entity_relation[1] (0..*)	Entity_relation_graph[1] Entity_relation[1]

[1] Defined in the Image DTD7

A basic element of the present video description scheme (DS) is the video object (<video_object>) 930. A video object 930 refers to one or more arbitrary regions in one or more frames of a video clip. For example, and not by way of limitation, a video object may be defined as local objects, segment objects and global objects. Local objects refer to a group of pixels found in one or more frames . Segment objects refer to one or more related frames of the video clip. Global objects refer to the entire video clip.

A video object 930 is an element of the video object set 924 and can be related to other objects in the object set 924 by the object hierarchy 926 and entity relation graphs 928 in the same manner as described in connection with Figs. 1-6. Again, the fundamental difference between the video description scheme and the previously described image description scheme resides in the inclusion of temporal parameters which will further define the video objects and their interrelation in the description scheme.

In using XML to implement the present video description scheme, to indicate if a video object has associated semantic information, the video object can include a "semantic" attribute which can take on an indicative value, such as true or false. To indicate if the object has associated physical information (such as color, shape, time, motion and position), the object can include an optional "physical" attribute that can take on an indicative value, such as true or false. To indicate whether regions of an object are spatially adjacent to one another (continuous in space), the object can include an optional "spaceContinuous" attribute that can assume a value such as true or false. To indicate if the video frames which contain a particular object are temporally adjacent to one another (continuous in time), the

object can further include an optional "timeContinuous" attribute. This attribute can assume an indicative value, such as true or false. To distinguish if the object refers to a region within select frames of a video, to entire frames of the video, or to the entire video commonly (e.g. shots, scenes, stories), the object will generally include an attribute (type), that can have multiple indicative values such as, LOCAL, SEGMENT, and GLOBAL, respectively.

Figure 10 is a pictorial diagram which depicts a video clip from a video clip wherein a number of exemplary objects are identified. Object O0, is a global object which refers to the entire video clip. Object O1, the library, refers to an entire frame of video and would be classified as a segment type object. Objects O2 and O3 are local objects which refer to narrator A and narrator B, respectively, which are person objects that are continuous in time and space. Object O4 ("Narrators") are local video objects (O2, O3) which is discontinuous in space. Figure 10 further illustrates that objects can be nested. For example, object O1, the library, includes local object O2, and both of these objects are contained within the global object O0. An XML description of the objects defined in Figure 10 is set forth below.

```
<video_object_set>
        <video_object id="O0" type="GLOBAL"> <video_object> <!--Documentary -->
        <video_object id="O1" type="SEGMENT"> </video_object> <!--Library -->
        <video_object id="O2" type="LOCAL"> </video_object> <!-- Narrator A -->
        <video_object id="O3" type="LOCAL"> </video_object> <!--Narrator B -->
        <video_object id="O4" type="LOCAL"> </video_object> <!--Narrators -->
</image_object_set>
```

Figure 11 illustrates how two or more video objects are related through the object hierarchy 926. In this case, objects O2 and O3 have a common semantic feature of "what object" being a narrator. Thus, these objects can be referenced in the definition of a new object, O4, narrators, via an object hierarchy definition. The details of such hierarchical definition follow that described in connection with Fig. 3A.

Figure 12 illustrates how the entity relation graph in the video description scheme can relate video objects. In this case, two relationships are shown between objects O2 and O3. The first is a semantic relationship, "colleague of", which is equivalent to the type of semantic relationship which could be present in the case of the image description scheme, as described in connection with Figure 1C.. Figure 12 further shows a temporal relationship between the objects O2 and O3. In this case, object O2 precedes object O3 in time within the video clip, thus the temporal relationship "before" can be applied. In addition to the exemplary relation types and relations set forth in connection with the image description scheme, the video description scheme can employ the relation types and relations set forth in the table below.

RELATION TYPE	RELATIONS
TEMPORAL- Directional	Before, After, Immediately Before, Immediately After
TEMPORAL-Topological	Co-Begin, Co-End, Parallel, Sequential, Overlap, Within, Contain, Nearby

The video objects 930 can be further characterized in terms of object features. Although any number and type of features can be defined to characterize the video objects in a modular and extensible manner, a useful exemplary feature set can include semantic features 940, visual features 938, media features 936 and temporal features 937. Each feature can then be further defined by feature parameters, or descriptors. Such descriptors will generally follow that described in connection with the image description scheme, with the addition of requisite temporal information. For example, visual features 938 can include a set of descriptors such as shape, color, texture, and position, as well as motion parameters. Temporal features 937 will generally include such descriptors as start time, end time and duration. Table 6 shows examples of descriptors, in addition to those set forth in connection with the image description scheme, that can belong to each of these exemplary classes of features.

Table 6: Feature classes and features.

Feature Class	Features
Visual	Motion, Editing effect, Camera Motion
Temporal	Start Time, End Time, Duration

In summary, in a fashion analogous to the previously described image description scheme, the present video description scheme includes a video object set 924, an object hierarchy 926, and entity relation graphs 928. Video objects 930 are further defined by features. The objects 930 within the object set 924 can be related hierarchically by one or more object hierarchy nodes 932 and references 933. Relations between objects 930 can also be expressed in entity relation graphs 928, which further include entity relations 934, entity nodes 942, references 943 and relations 944, all of which substantially correspond in the manner described in connection with Figure 2. Each video object 930 preferably includes features that can link to external extraction and similarity matching code.

Figure 13 is a block diagram of an exemplary computer system for implementing the present video description systems and methods, which is analogous to the system described in connection with Figure 5. The system includes a computer processor section 1302 which receives digital data representing video content, such as via video input interface 1304. Alternatively, the digital video data can be transferred to the processor from a remote source via a bidirectional communications input/output port 1306. The video content can also be transferred to the processor section 1302 from computer accessible media 408, such as optical data storage systems or magnetic storage systems which are known in the art. The processor section 1302 provides data to a video display system 1310, which generally includes appropriate interface circuitry and a high resolution monitor, such as a standard SVGA monitor and video card commonly employed in conventional personal computer systems and workstations. A user input device 1312, such as a keyboard and digital pointing device, such as a mouse, trackball, light pen, touch screen and the like, is operatively coupled to the processor section 1302 to effect user interaction with the system. The

system will also generally include volatile and non volatile computer memory 1314 which can be accessed by the processor section during processing operations.

Figure 14 is a flow diagram which generally illustrates the processing operations undertaken by processor section 1302 in establishing the video DS described in connection with Figures 9-12. Digital data representing a video clip is applied to the system, such as via video input interface 1304 and is coupled to the processor section 1302. The processor section 1302, under the control of suitable software, performs video object extraction processing 1402 wherein video objects 930, features 936, 937, 938, 940 and the associated descriptors are generated. Video object extraction processing 1402 can take the form of a fully automatic processing operation, a semi-automatic processing operation, or a substantially manual operation where objects are largely defined through user interaction via the user input device 1312.

The result of object extraction processing is the generation of an object set 924, which contains one or more video objects 930 and associated object features 936, 937, 938, 940 . The video objects 930 of the object set 924 are subjected to further processing in the form of object hierarchy construction and extraction processing 1404 and entity relation graph generation processing 1406. Preferably, these processing operations take place in a parallel fashion. The output result from object hierarchy construction and extraction processing 1404 is an object hierarchy 926. The output result of entity relation graph generation processing 506 is one or more entity relation graphs 928. The processor section 1302 combines the object set, object hierarchy and entity relation graphs into a description record in accordance with the present video description scheme for the applied video content. The description record can be stored in database storage 1410, subjected to low-level encoding 1412 (such as binary coding) or subjected to description language encoding (e.g. XML) 1414. Once the description records are stored in the read/write storage 1308 in the form of a database, the data is available in a useful format for use by other applications 1416, such as search, filter, archiving applications and the like.

Exemplary Document Type Definition of Video Description scheme

This section discusses one embodiment wherein XML has been used to implement a document type definition (DTD) of the present video description scheme. Table 1, set forth above, summarizes the DTD of the present video DS. Appendix A includes the full listing of the DTD of the video DS. In general, a Document Type Definition (DTD) provides a list of the elements, tags, attributes, and entities contained in the document, and their relationships to each other. In other words, DTDs specify a set of rules for the structure of a document. DTDs may be included in a computer data file that contains the document they describe, or they may be linked to or from an external universal resource location (URL). Such external DTDs can be shared by different documents and Web sites. A DTD is generally included in a document's prolog after the XML declaration and before the actual document data begins.

Every tag used in a valid XML document must be declared exactly once in the DTD with an element type declaration. The first element in a DTD is the root tag. In our video DS, the root tag can be designated as <video> tag. An element type declaration specifies the name of a tag, the allowed children of the tag, and whether the tag is empty. The root <video> tag can be defined, as follows:

<!ELEMENT video (video_object_set, object_hierarchy*, entity_relation_graph*)>

where the asterisk (*) indicates zero or more occurrences. In XML syntax, the plus sign (+) indicates one ore more occurrences and the question mark (?) indicates zero or one occurrence.

In XML, all element type declarations start with <!ELEMENT and end with >. They include the name of the tag being declared video and the allowed contents (video_object_set, object_hierarchy*, entity_relation_graph*). This declaration indicates that a video element must contain a video object set element (<video_object_set>), zero or more object hierarchy elements (<object_hierarchy>), and zero or more entity relation graph elements (<entity_relation_graph>).

The video object set 924 can be defined as follows.

```
<!-- Video object set element  -->
<!-- An object set consists of one or more video objects -->
<! ELEMENT video_object_set (video_object+)>
<!-- Video object element -->
<!-- Video object elements consist of the following elements:
- optional vid_obj_media_features element
- optional vid_obj_semantic_features element
- optional vid_obj_visual_features element
- optional vid_obj_temporal_features element -->
<!ELEMENT video_object (vid_obj_media_features?,
vid_obj_semantic_features?,
                    vid_obj_visual_features?,
vid_obj_temporal_features?)>
<!-- Video object elements must have a unique ID attribute in each description -->
<!ATTLIST video_object
        type (LOCAL|SEGMENT|GLOBAL) #REQUIRED
        id ID #IMPLIED
        object_ref IDREF #IMPLIED
        object_node_ref IDREFS #IMPLIED
        entity_node_ref IDREFS #IMPLIED>
<!-- Feature elements: media, semantic, temporal and visual -->
<!-- Video object media features element consists an optional location,
file_format, file_size, resolution, modality_transcoding, and bit_rate elements
-->
<!ELEMENT vid_obj_media_features (location?, file_format?, file_size?,
resolution?,
                                    modality_transcoding?, bit_rate?)>
<!-- Video object semantic features element consists an optional text_annotation and
the 6-W elements -->
<!ELEMENT vid_obj_semantic_features (text_annotation?, who?, what_action?,
                                    where?, why?, when?)>
```

<!-- Video object visual features element consists image_scl, color, texture, shape, size, position, motion, video_scl, visual_sprite, transition, and camera_motion elements, and multiple key_frame elements-->
<!ELEMENT vid_obj_visual_features (image_scl?, color?, texture?, shape?, size?, position?, motion?, video_scl?, visual_sprite?, transition?, camera_motion?, key_frame*)>

In the above example, the first declaration indicates that a video object set element (<video_object_set>) 924 contains one or more video objects (<video_object>) 930. The second declaration indicates that a video object 930 contains an optional video object media feature (<vid_obj_media_features>)936, semantic feature (<vid_obj_ semantic_features>) 940, visual feature (<vid_obj_visual_features>) 938, and temporal feature (<vid_obj_temporal_features>) 937 elements. In addition, the video object tag is defined as having one required attribute, type, that can only have three possible values (LOCAL, SEGMENT, GLOBAL); and three optional attributes, id, object_ref, and object_node_ref, of type ID, IDREFS, and IDREFS, respectively.

Some XML tags include attributes. Attributes are intended for extra information associated with an element (like an ID). The last four declarations in the example shown above corresponds to the video object media feature 936, semantic feature 940, visual feature 938, and temporal feature 937 elements. These elements group feature elements depending on the information they provide. For example, the media features element (<vid_obj_media_features>) 936 contains an optional location, file_format, file_size, resolution, modality_transcoding, and bit_rate element to define the descriptors of the media features 936. The semantic feature element (<vid_obj_semantic_features>) contains an optional text_annotation and the 6-W elements corresponding to the semantic feature descriptors 940. The visual feature element (<vid_obj_visual_features>) contains optional image_scl, color, texture, shape, size, position, video_scl, visual_sprite, transition, camera_motion elements, and multiple key_frame elements for the visual feature descriptors . The temporal

features element (<vid_obj_temporal_features>) contains an optional time element as the temporal feature descriptor.

In the exemplary DTD listed in Appendix A, for the sake of clarity and flexibility feature elements are declared in external DTDs using entities. The following description sets forth a preferred method of referencing a separate external DTD for each one of these elements.

In the simplest case, DTDs include all the tags used in a document. This technique becomes unwieldy with longer documents. Furthermore, it may be desirable to use different parts of a DTD in many different places. External DTDs enable large DTDs to be built from smaller ones. That is, one DTD may link to another and in so doing pull in the elements and entities declared in the first. Smaller DTD's are easier to analyze. DTDs are connected with external parameter references, as illustrated in the example following:

```
<!ENTITY % camera_motion PUBLIC
"http://www.ee.columbia.edu/mpeg7/xml/features/camera_motion.dtd">
%camera_motion;
```

The object hierarchy can be defined in the image DTD. The following example provides an overview of a declaration for the present object hierarchy element.

```
<!-- Object hierarchy element -->
<!-- A hierarchy element consists of one root node -->
<!ELEMENT object_hierarchy (object_node)>
<!-- The object hierarchy element has two optional attributes: an id and a type -->
<!ATTLIST object_hierarchy
        id ID #IMPLIED
        type CDATA #IMPLIED>
<!-- Object node element -->
<!-- Object node elements consist of zero or more object node elements -->
<!ELEMENT object_node (object_node*)>
<!-- Object node elements must have an id attribute of type ID. -->
```

```
<!ATTLIST object_node
        id ID #IMPLIED
        object_ref IDREF #REQUIRED>
```

The object hierarchy element (<object_hierarchy>) preferably contains a single root object node element (<object_node>). An object node element generally contains zero or more object node elements. Each object node element can have an associated unique identifier, id. The identifier is expressed as an optional attribute of the elements of type ID, e.g. <object_node id="on1" object_ref="o1">. Each object node element can also include a reference to a video object element by using the unique identifier associated with each video object. The reference to the video object element is given as an attribute of type IDREF (object_ref). Object elements can link back to those object node elements pointing at them by using an attribute of type IDREFS (object_node_ref).

The entity relation graph definition is very similar to the object hierarchy's one. An example, is listed below.

```
<!-- Entity relation graph element -->
<!-- A entity relation graph element consists of zero or more entity relation elements
-->
<!ELEMENT entity_relation_graph (entity_relation+)>
<!-- A entity relation graph element can include two attributes: an id and a type -->
<!-- Possible types of entity relation graphs and entity relations follow:
        - Spatial: topological, directional
        - Temporal: topological, directional
        - Semantic -->
<!ATTLIST entity_relation_graph
        id ID #IMPLIED
        type CDATA #IMPLIED>
<!-- Entity relation element -->
<!-- A entity relation graph element consists of one relation, and zero or more entity
nodes or entity relation elements -->
```

```
<!ELEMENT entity_relation (relation, (entity_node | entity_node_set |
entity_relation)*)>
<!-- A entity relation element can include a type attribute -->
<!ATTLIST entity_relation
        type CDATA #IMPLIED>

<!-- Entity relation element -->
<!-- Examples of relations are
        - SPATIAL.TOPOLOGICAL: overlap, etc.
        - SPATIAL.DIRECTIONAL: to the left, to the right, etc.
        - TEMPORAL.TOPOLOGICAL: at the same time, etc.
        - TEMPORAL.DIRECTIONAL: before, after, immediately before, etc.
        - SEMANTIC: father of, etc. -->
<!ELEMENT relation (#PCDATA | code)*>

<!-- Entity node element -->
<!-- This element can contain string data. It can have a unique attribute (id), and
must include a reference attribute to an object element (object_ref) -->
<!ELEMENT entity_node (#PCDATA)>
<!ATTLIST entity_node
        id ID #IMPLIED
        object_ref IDREF #REQUIRED>
<!-- Entity node set element -->
<!ELEMENT entity_node_set (entity_node+)>
```

The declaration of the entity node element can contain either one or another element by separating the child elements with a vertical bar rather than a comma.

The description above sets forth a data structure of a video description scheme, as well as systems and methods of characterizing video content in accordance with the present video description scheme. Of course, the present video description scheme can be used advantageously in connection with the systems described in connection with Figures 7 and 8.

Although the present invention has been described in connection with specific exemplary embodiments, it should be understood that various changes, substitutions and alterations can be made to the disclosed embodiments without departing from the spirit and scope of the invention as set forth in the appended claims.

CLAIMS

1. A system for generating a description record from video information, comprising:

at least one video input interface for receiving said video information;

a computer processor coupled to said at least one video input interface for receiving said video information therefrom, processing said video information by performing video object extraction processing to generate video object descriptions from said video information, processing said generated video object descriptions by object hierarchy construction and extraction processing to generate video object hierarchy descriptions, and processing said generated video object descriptions by entity relation graph generation processing to generate entity relation graph descriptions, wherein at least one description record including said video object descriptions, said video object hierarchy descriptions and said entity relation graph descriptions is generated to represent content embedded within said video information; and

a data storage system, operatively coupled to said processor, for storing said at least one description record.

2. The system of claim 1, wherein said video object extraction processing and said object hierarchy construction and extraction processing are performed in parallel.

3. The system of claim 1, wherein said video object extraction processing comprises:

video segmentation processing to segment each video in said video information into regions within said video; and

feature extraction and annotation processing to generate one or more feature descriptions for one or more said regions;

whereby said generated video object descriptions comprise said one or more feature descriptions for one or more said regions.

4. The system of claim 3, wherein said regions are selected from the group consisting of local, segment and global regions.

5. The system of claim 3, wherein said one or more feature descriptions are selected from the group consisting of media features, visual features, temporal features, and semantic features.

6. The system of claim 5, wherein said semantic features are further defined by at least one feature description selected from the group consisting of who, what object, what action, where, when, why, and text annotation.

7. The system of claim 5, wherein said visual features are further defined by at least one feature description selected from the group consisting of color, texture, position, size, shape, motion, camera motion, editing effect, and orientation.

8. The system of claim 5, wherein said media features are further defined by at least one feature description selected from the group consisting

of file format, file size, color representation, resolution, data file location, author, creation, scalable layer and modality transcoding.

9. The system of claim 5, wherein said temporal features are further defined by at least one feature description selected from the group consisting of start time, end time and duration.

10. The system of claim 1, wherein said object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on visual feature relationships of video objects represented by said video object descriptions.

11. The system of claim 1, wherein said object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on semantic feature relationships of video objects represented by said video object descriptions.

12. The system of claim 1, wherein said object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on media feature relationships of video objects represented by said video object descriptions.

13. The system of claim 1, wherein said object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on relationships of video objects represented by said video object descriptions, wherein said relationships are selected from the

group consisting of visual feature relationships, semantic feature relationships, temporal feature relationships and media feature relationships.

14. The system of claim 1, wherein said object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on relationships of video objects represented by said video object descriptions, wherein said video object hierarchy descriptions have a plurality of hierarchical levels.

15. The system of claim 14, wherein said video object hierarchy descriptions having a plurality of hierarchical levels comprise clustering hierarchies.

16. The system of claim 15, wherein said clustering hierarchies are based on relationships of video objects represented by said video object descriptions, wherein said relationships are selected from a group consisting of visual feature relationships, semantic feature relationships, temporal relationships and media feature relationships.

17. The system of claim 15, wherein said video object hierarchy descriptions having a plurality of hierarchical levels are configured to comprise multiple levels of abstraction hierarchies.

18. The method of claim 17, wherein said multiple levels of abstraction hierarchies are configured to be based on relationships of video objects represented by said video object descriptions, wherein said relationships are selected from a group consisting of visual feature relationships, semantic feature relationships, temporal feature relationships and media feature relationships.

19. The system of claim 1, wherein said entity relation graph generation processing generates entity relation graph descriptions of said video object descriptions based on relationships of video objects represented by said video object descriptions, wherein said relationships are selected from the group consisting of visual feature relationships, semantic feature relationships, temporal feature relationships and media feature relationships.

20. The system of claim 1, further comprising an encoder for receiving and encoding said video object descriptions into encoded description information, wherein said data storage system is operative to store said encoded description information as said at least one description record.

21. The system of claim 1, wherein said video object descriptions, said video object hierarchy descriptions, and said entity relation graph descriptions are combined together to form video descriptions, and further comprising an encoder for receiving and encoding said video descriptions into encoded description information, wherein said data storage system is operative to store said encoded description information as said at least one description record.

22. The system of claim 21, wherein said encoder comprises a binary encoder.

23. The system of claim 21, wherein said encoder comprises an XML encoder.

24. The system of claim 1, further comprising:

a video display device operatively coupled to the computer processor for displaying the video information; and

at least one user input device operatively coupled to the computer processor, wherein at least a portion of said video object processing includes receiving a user input through manipulation of said user input device.

25. A method for generating a description record from video information, comprising the steps of:

receiving said video information;

processing said video information by performing video object extraction processing to generate video object descriptions from said video information;

processing said generated video object descriptions by object hierarchy construction and extraction processing to generate video object hierarchy descriptions;

processing said generated video object descriptions by entity relation graph generation processing to generate entity relation graph descriptions, wherein at least one description record including said video object descriptions, said video object hierarchy descriptions and said entity relation graph descriptions is generated to represent content embedded within said video information; and

storing said at least one description record.

26. The method of claim 25, wherein said steps of video object extraction processing and object hierarchy construction and extraction processing are performed in parallel.

27. The method of claim 25, wherein said step of video object extraction processing comprises the further steps of:

video segmentation processing to segment each video in said video information into regions within said video; and

feature extraction and annotation processing to generate one or more feature descriptions for one or more said regions;

whereby said generated video object descriptions comprise said one or more feature descriptions for one or more said regions.

28. The method of claim 27, wherein said regions are selected from the group consisting of local, segment and global regions.

29. The method of claim 27, further comprising the step of selecting said one or more feature descriptions from the group consisting of media features, visual features, temporal and semantic features.

30. The method of claim 29, wherein said semantic features are further defined by at least one feature description selected from the group consisting of who, what object, what action, where, when, why and text annotation.

31. The method of claim 29, wherein said visual features are further defined by at least one feature description selected from the group consisting of color, texture, position, size, shape, motion, editing effect, camera motion and orientation.

32. The method of claim 29, wherein said media features are further defined by at least one feature description selected from the group consisting of file format, file size, color representation, resolution, data file location, author, creation, scalable layer and modality transcoding.

33. The method of claim 29, wherein said temporal features are further defined by at least one feature description selected from the group consisting of start time, end time and duration.

34. The method of claim 25, wherein said step of object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on visual feature relationships of video objects represented by said video object descriptions.

35. The method of claim 25, wherein said step of object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on semantic feature relationships of video objects represented by said video object descriptions.

36. The method of claim 25, wherein said step of object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on media feature relationships of video objects represented by said video object descriptions.

37. The method of claim 25, wherein said step of object hierarchy construction and extraction processing generates video object hierarchy

descriptions of said video object descriptions based on temporal feature relationships of video objects represented by said video object descriptions.

38. The method of claim 25, wherein said step of object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on relationships of video objects represented by said video object descriptions, wherein said relationships are selected from the group consisting of visual feature relationships, semantic feature relationships, temporal feature relationships and media feature relationships.

39. The method of claim 25, wherein said step of object hierarchy construction and extraction processing generates video object hierarchy descriptions of said video object descriptions based on relationships of video objects represented by said video object descriptions, wherein said video object hierarchy descriptions are configured to have a plurality of hierarchical levels.

40. The method of claim 39, wherein said video object hierarchy descriptions having a plurality of hierarchical levels are configured to comprise clustering hierarchies.

41. The method of claim 40, wherein said clustering hierarchies are configured to be based on relationships of video objects represented by said video object descriptions, wherein said relationships are selected from a group consisting of visual feature relationships, semantic feature relationships, temporal feature relationships and media feature relationships.

42. The method of claim 40, wherein said video object hierarchy descriptions having a plurality of hierarchical levels are configured to comprise multiple levels of abstraction hierarchies.

43. The method of claim 40, wherein said multiple levels of abstraction hierarchies are configured to be based on relationships of video objects represented by said video object descriptions, wherein said relationships are selected from a group consisting of visual feature relationships, semantic feature relationships, temporal feature relationships and media feature relationships.

44. The method of claim 25, wherein said step of entity relation graph generation processing generates entity relation graph descriptions of said video object descriptions based on relationships of video objects represented by said video object descriptions, wherein said relationships are selected from the group consisting of visual feature relationships, semantic feature relationships, temporal feature relationships and media feature relationships.

45. The method of claim 25, further comprising the steps of receiving and encoding said video object descriptions into encoded description information, and storing said encoded description information as said at least one description record.

46. The method of claim 25, further comprising the steps of combining said video object descriptions, said video object hierarchy descriptions, and said entity relation graph descriptions to form video descriptions, and receiving and encoding said video descriptions into encoded description information, and storing said encoded description information as said at least one description record.

47. The method of claim 46, wherein said step of encoding comprises the step of binary encoding.

48. The method of claim 46, wherein said step of encoding comprises the step of XML encoding.

49. A computer readable media containing digital information with at least one description record representing video content embedded within corresponding video information, the at least one description record comprising:

one or more video object descriptions generated from said video information using video object extraction processing;

one or more video object hierarchy descriptions generated from said generated video object descriptions using object hierarchy construction and extraction processing; and

one or more entity relation graph descriptions generated from said generated video object descriptions using entity relation graph generation processing.

50. The computer readable media of claim 49, wherein said video object descriptions, said video object hierarchy descriptions, and said entity relation graph descriptions further comprise one or more feature descriptions.

51. The computer readable media of claim 50, wherein said one or more feature descriptions are selected from the group consisting of media features, visual features, temporal features and semantic features.

52. The computer readable media of claim 51, wherein said semantic features are further defined by at least one feature description selected from the group consisting of who, what object, what action, where, when, why and text annotation.

53. The computer readable media of claim 51, wherein said visual features are further defined by at least one feature description selected from the group consisting of color, texture, position, size, shape, motion, camera motion, editing effect and orientation.

54. The computer readable media of claim 51, wherein said media features are further defined by at least one feature description selected from the group consisting of file format, file size, color representation, resolution, data file location, author, creation, scalable layer and modality transcoding.

55. The computer readable media of claim 51, wherein said temporal features are further defined by at least one feature description selected from the group consisting of start time, end time and duration.

56. The computer readable media of claim 49, wherein said object hierarchy descriptions are based on visual feature relationships of video objects represented by said video object descriptions.

57. The computer readable media of claim 49, wherein said video object hierarchy descriptions are based on semantic feature relationships of video objects represented by said video object descriptions.

58. The computer readable media of claim 49, wherein said video object hierarchy descriptions are based on media feature relationships of video objects represented by said video object descriptions.

59. The computer readable media of claim 49, wherein said video object hierarchy descriptions are based on temporal feature relationships of video objects represented by said video object descriptions.

60. The computer readable media of claim 49, wherein said video object hierarchy descriptions are based on relationships of video objects represented by said video object descriptions, wherein said video object hierarchy descriptions have a plurality of hierarchal levels.

61. The computer readable media of claim 60, wherein said video object hierarchy descriptions having a plurality of hierarchal levels comprise clustering hierarchies.

62. The computer readable media of claim 61, wherein said clustering hierarchies are based on relationships of video objects represented by said video object descriptions, wherein said relationships are selected from a group consisting of visual feature relationships, semantic feature relationships, temporal feature relationships and media feature relationships.

63. The computer readable media of claim 62, wherein said video object hierarchy descriptions having a plurality of hierarchical levels are configured to comprise multiple levels of abstraction hierarchies.

64. The computer readable media of claim 63, wherein said multiple levels of abstraction hierarchies are configured to be based on relationships of video objects represented by said video object descriptions, wherein said relationships are selected from a group consisting of visual feature relationships, semantic feature relationships, temporal feature relationships and media feature relationships.

65. The computer readable media of claim 49, wherein said entity relation graph descriptions are based on relationships of video objects represented by said video object descriptions, wherein said relationships are selected from the group consisting of visual feature relationships, semantic feature relationships, temporal feature relationships and media feature relationships.

66. The computer readable media of claim 49, wherein said video object descriptions are in the form of encoded description information.

67. The computer readable media of claim 49, wherein said video object descriptions, said video object hierarchy descriptions, and said entity relation graph descriptions are combined together in the form of encoded description information.

68. The computer readable media of claim 67, wherein said encoded description information is in the form of binary encoded information.

69. The computer readable media of claim 67, wherein said encoded description information is in the form of XML encoded information.

70. The system of claim 1, wherein feature descriptions include pointers to extraction and matching code to facilitate code downloading.

71. The system of claim 5, wherein feature descriptions include pointers to extraction and matching code to facilitate code downloading.

72. The method of claim 25, wherein feature descriptions include pointers to extraction and matching code to facilitate code downloading.

73. The method of claim 29, wherein feature descriptions include pointers to extraction and matching code to facilitate code downloading.

74. The computer readable media of claim 49, wherein feature descriptions include pointers to extraction and matching code to facilitate code downloading.

75. The computer readable media of claim 53, wherein feature descriptions include pointers to extraction and matching code to facilitate code downloading.

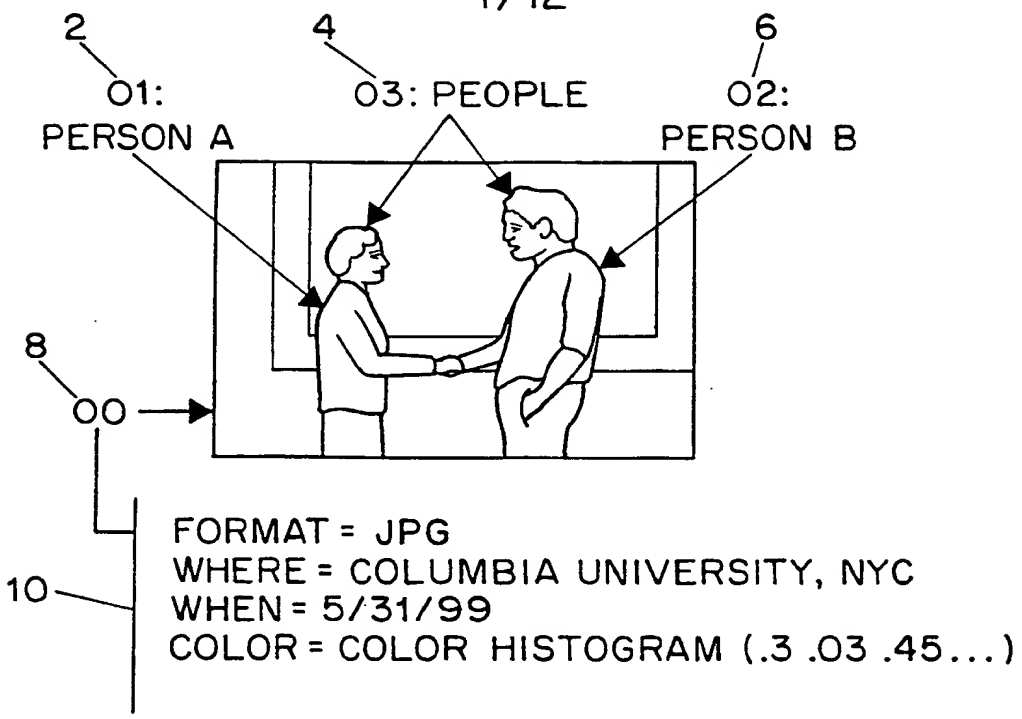

FIG. 1a

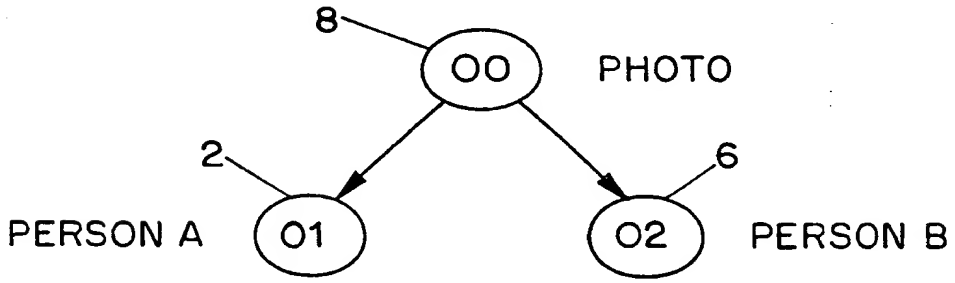

FIG. 1b

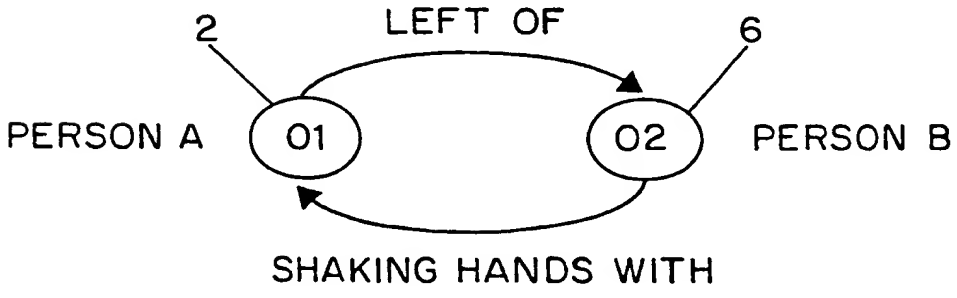

FIG. 1c

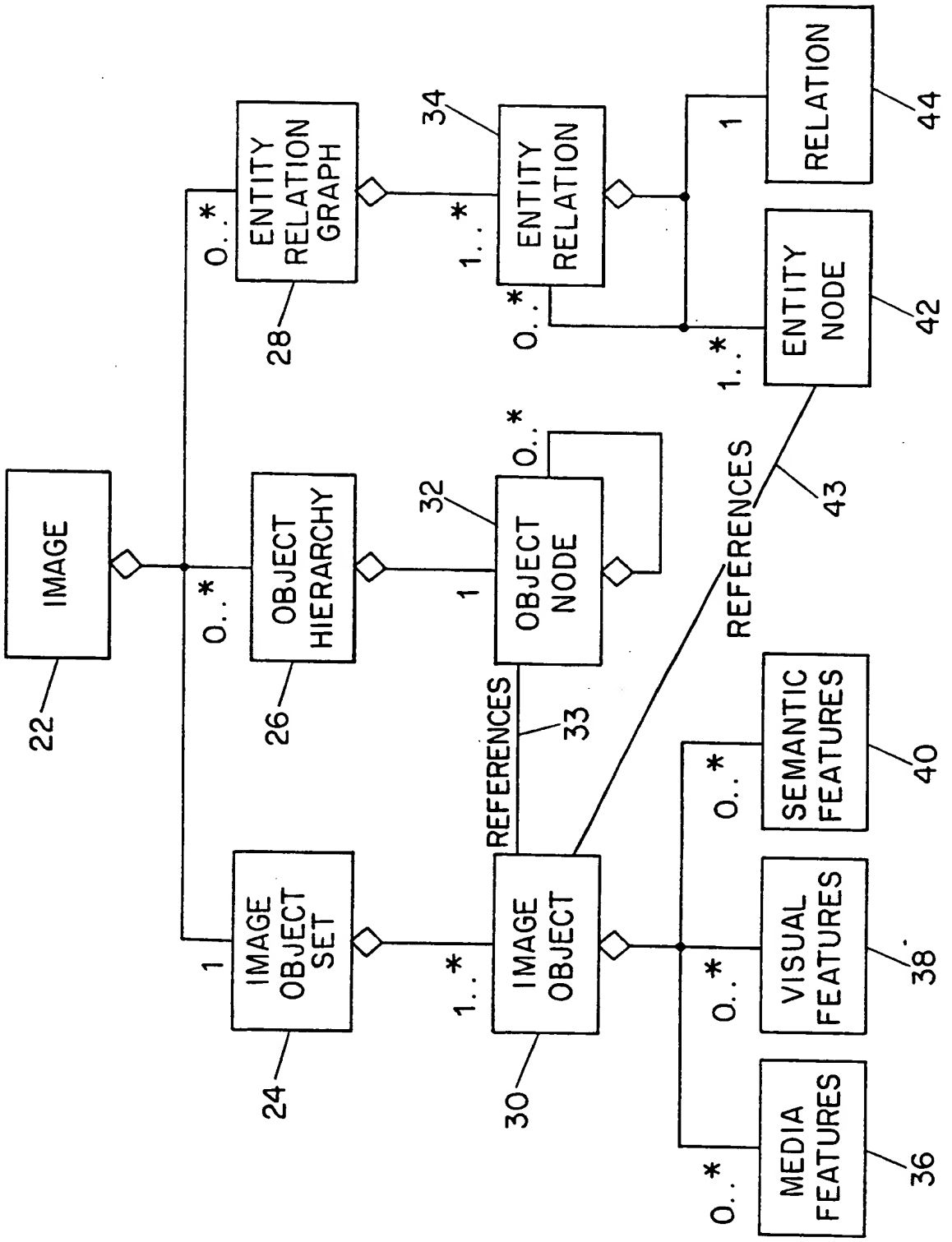
IMAGE
22
OBJECT HIERARCHY
26
ENTITY RELATION GRAPH
28
IMAGE OBJECT SET
24
OBJECT NODE
32
ENTITY RELATION
34
IMAGE OBJECT
30
ENTITY NODE
42
RELATION
44
REFERENCES
33
REFERENCES
43
SEMANTIC FEATURES
40
VISUAL FEATURES
38
MEDIA FEATURES
36
0..*
1..*
1

FIG. 2

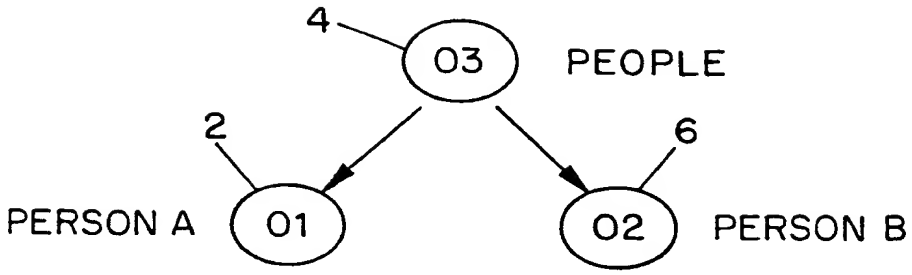
4
03
PEOPLE
2
6
PERSON A
01
02
PERSON B

FIG. 3a

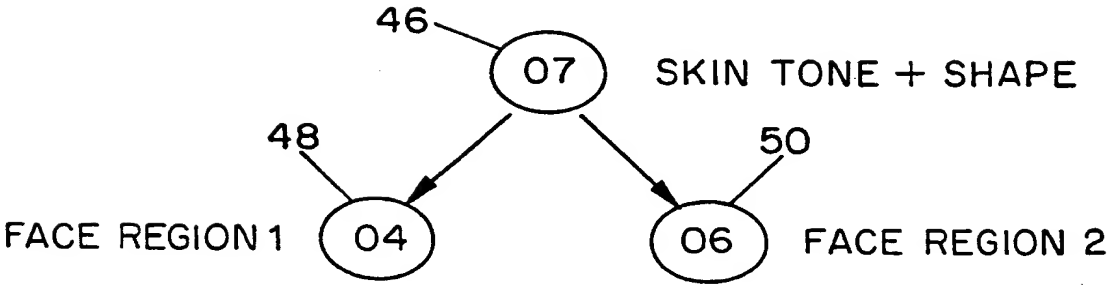
46
07
SKIN TONE + SHAPE
48
50
FACE REGION 1
04
06
FACE REGION 2

FIG. 3b

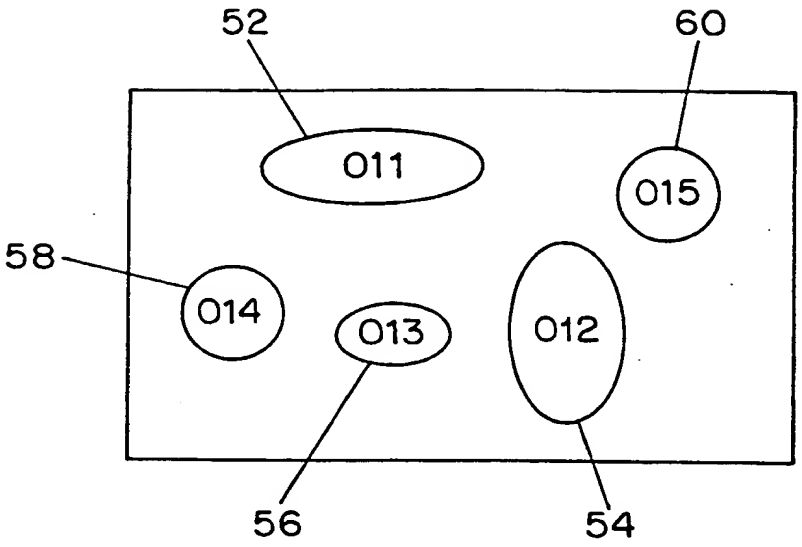
52
60
011
015
58
014
013
012
56
54

FIG. 4a

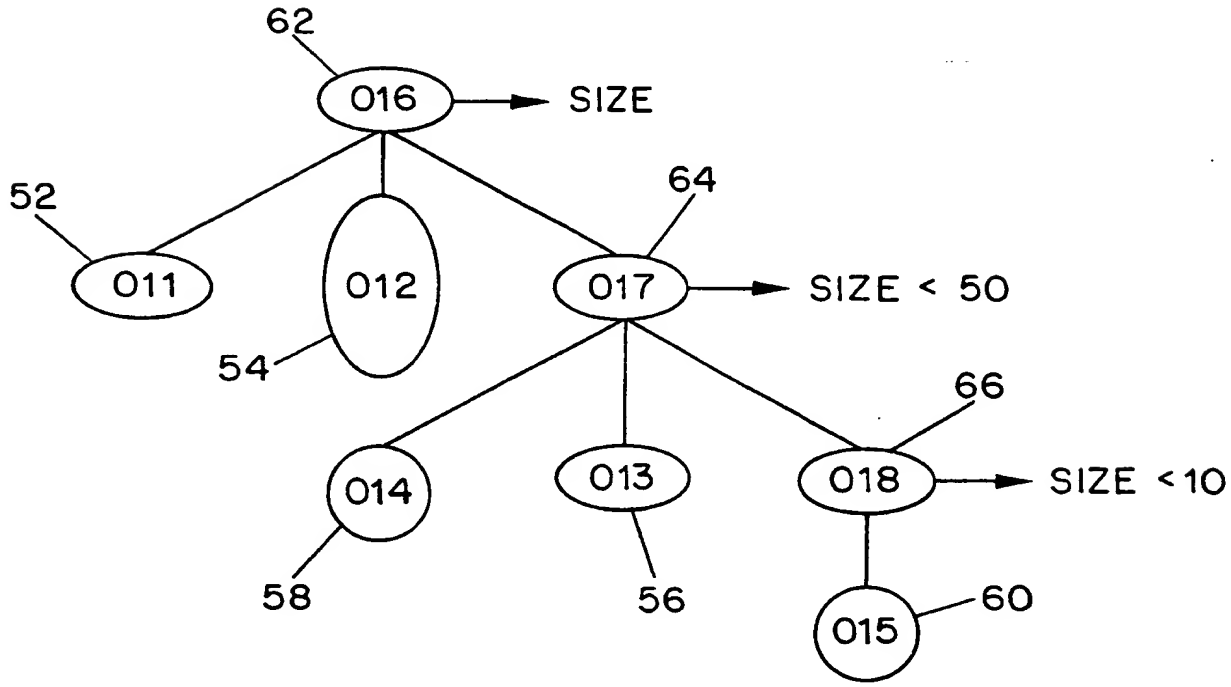
62
016
SIZE
52
64
011
012
017
SIZE < 50
54
66
014
013
018
SIZE <10
58
56
60
015

FIG. 4b

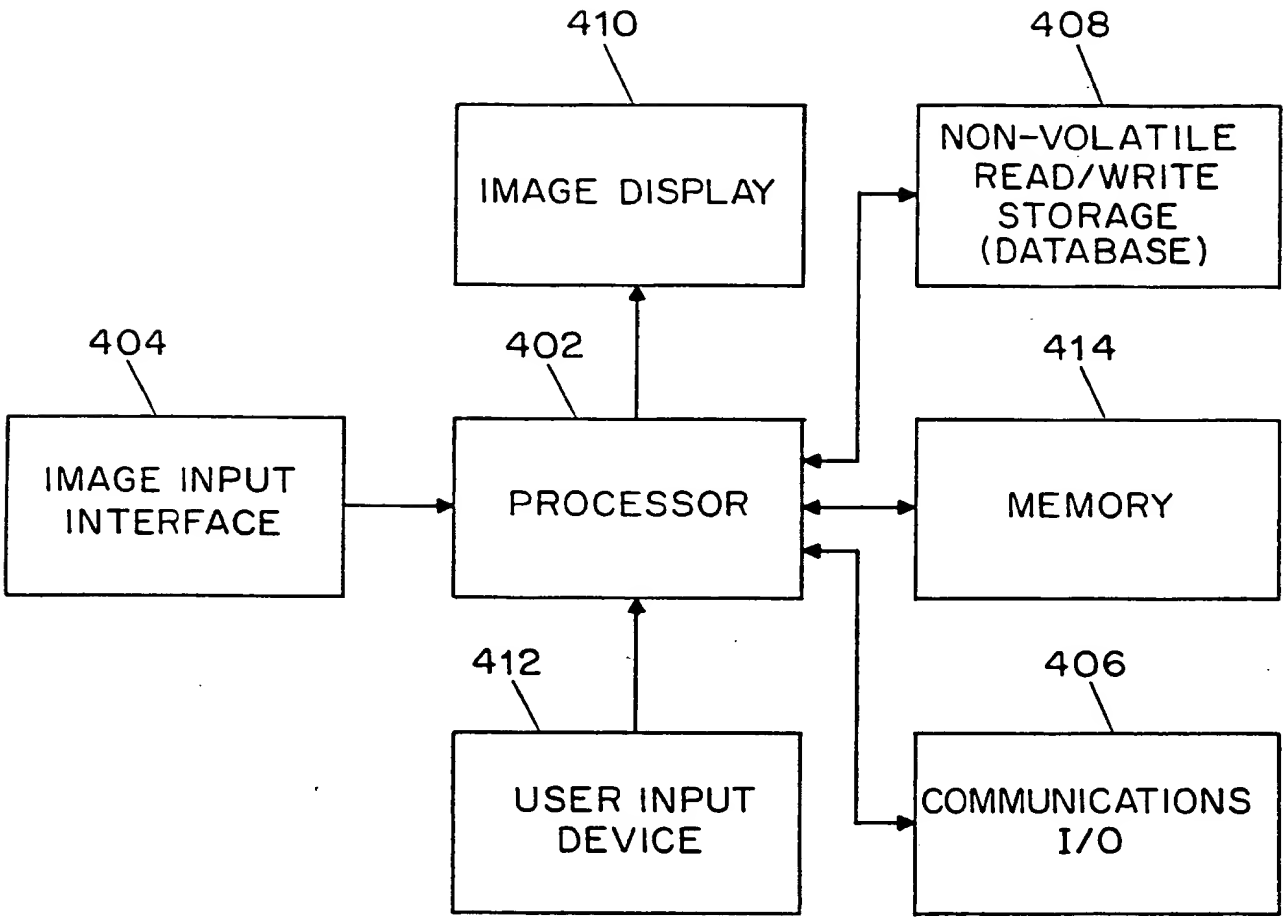
410
IMAGE DISPLAY
408
NON-VOLATILE READ/WRITE STORAGE (DATABASE)
404
IMAGE INPUT INTERFACE
402
PROCESSOR
414
MEMORY
412
USER INPUT DEVICE
406
COMMUNICATIONS I/O

FIG. 5

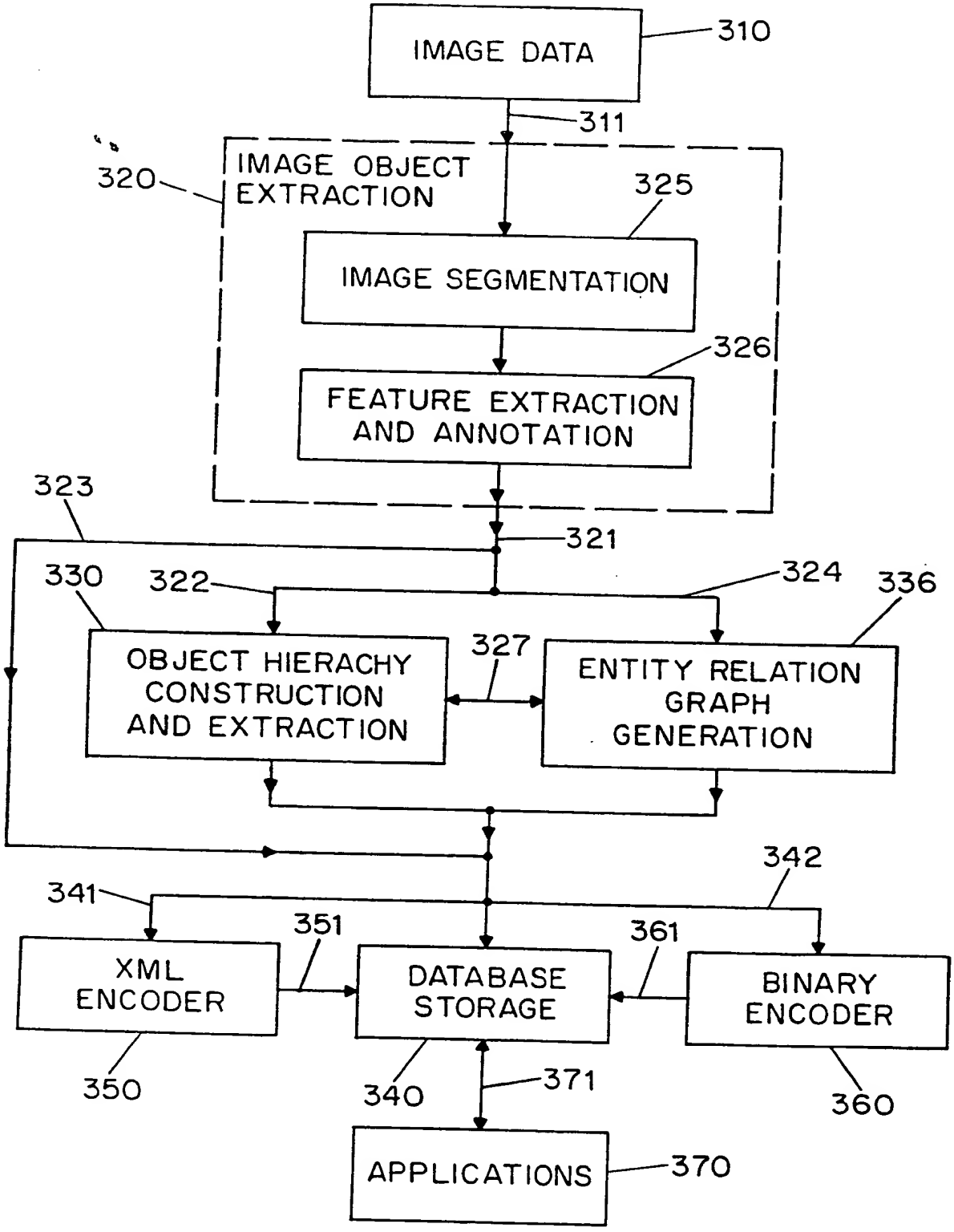
IMAGE DATA
310
311
IMAGE OBJECT EXTRACTION
320
325
IMAGE SEGMENTATION
326
FEATURE EXTRACTION AND ANNOTATION
323
321
330
322
324
336
OBJECT HIERACHY CONSTRUCTION AND EXTRACTION
327
ENTITY RELATION GRAPH GENERATION
342
341
351
361
XML ENCODER
DATABASE STORAGE
BINARY ENCODER
350
340
371
360
APPLICATIONS
370

FIG. 6

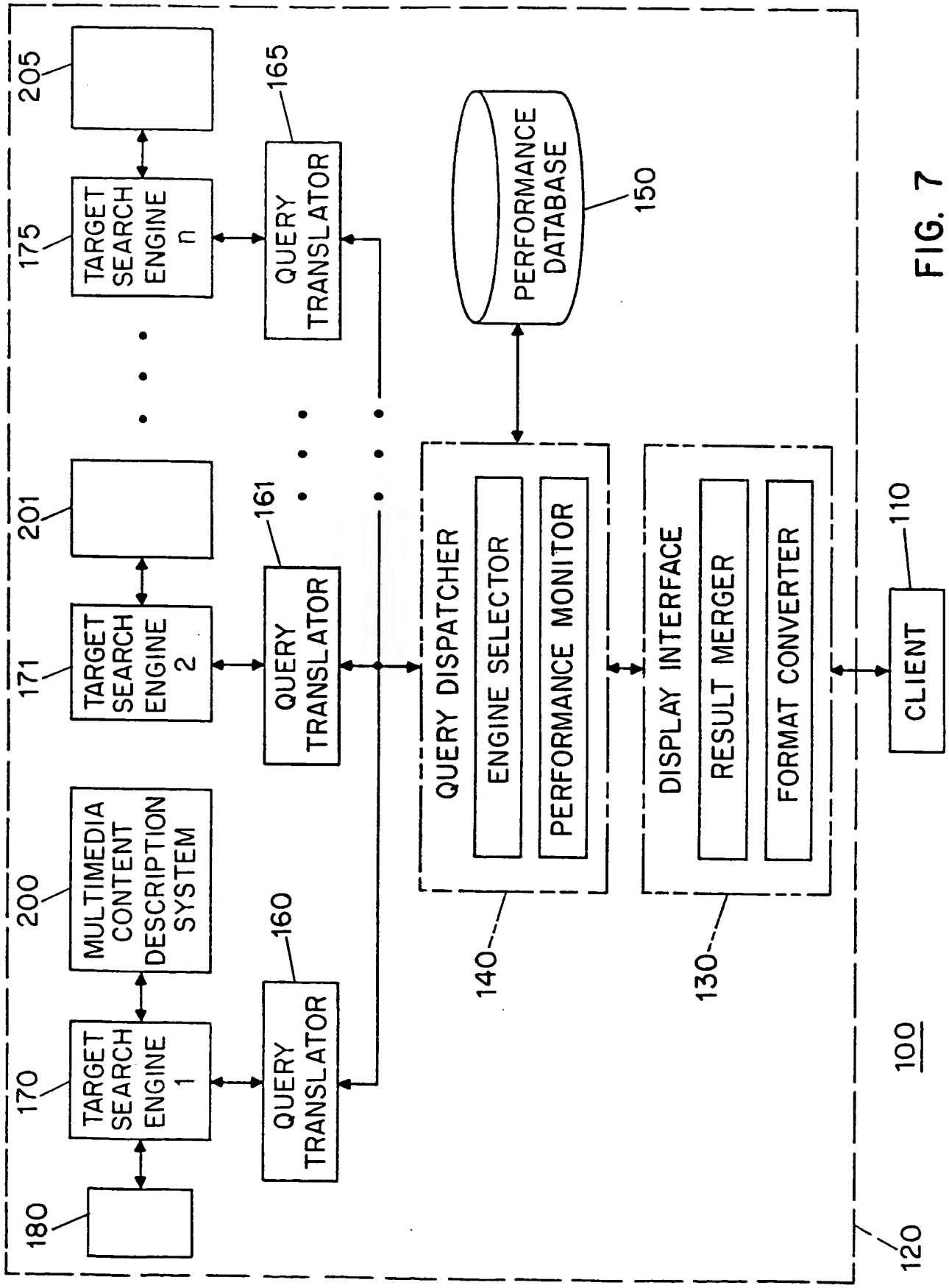
205
175
TARGET SEARCH ENGINE n
165
QUERY TRANSLATOR
PERFORMANCE DATABASE
150
201
171
TARGET SEARCH ENGINE 2
161
QUERY TRANSLATOR
QUERY DISPATCHER
ENGINE SELECTOR
PERFORMANCE MONITOR
DISPLAY INTERFACE
RESULT MERGER
FORMAT CONVERTER
110
CLIENT
200
MULTIMEDIA CONTENT DESCRIPTION SYSTEM
160
QUERY TRANSLATOR
170
TARGET SEARCH ENGINE 1
180
140
130
100
120

FIG. 7

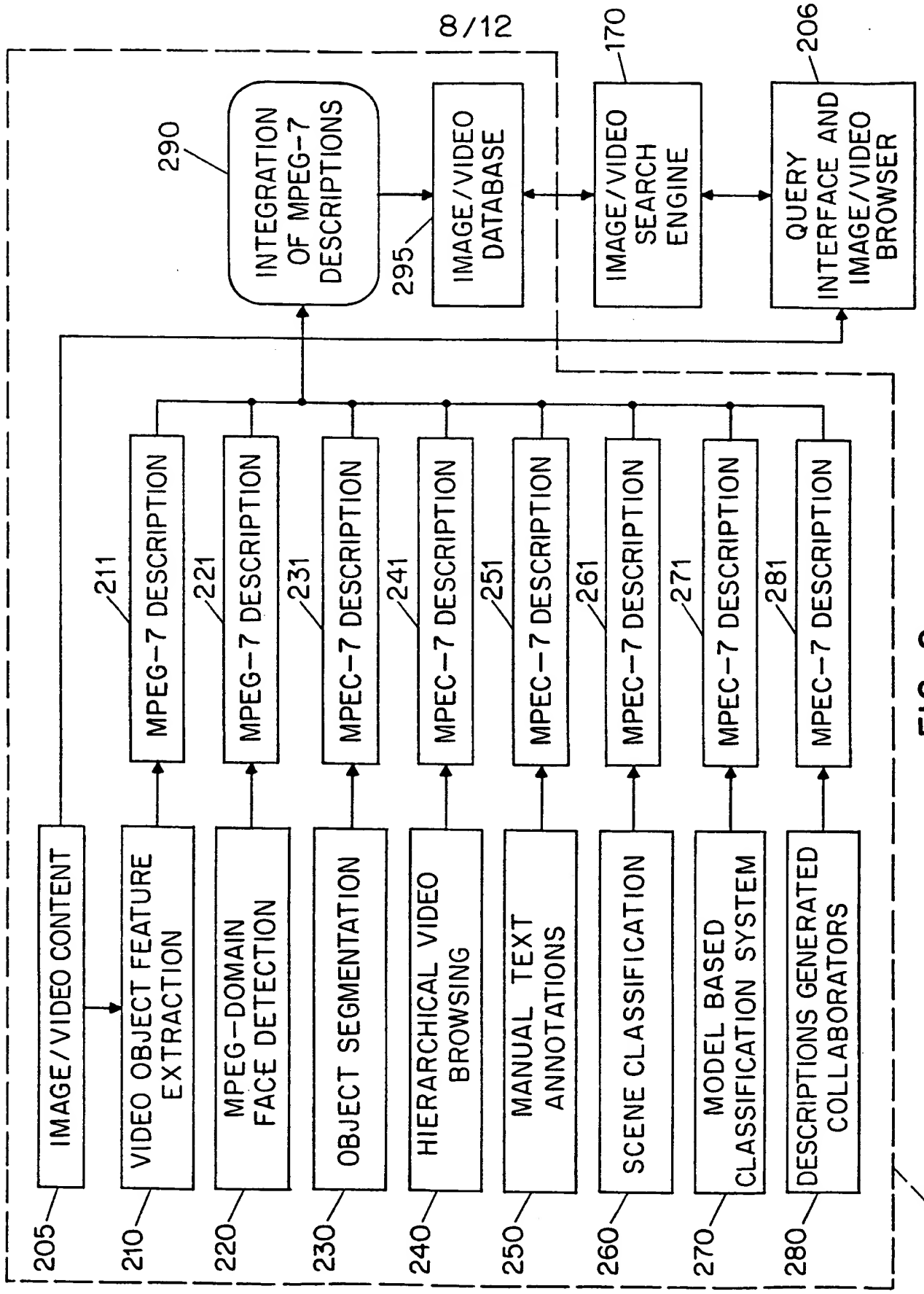
IMAGE/VIDEO CONTENT
VIDEO OBJECT FEATURE EXTRACTION
MPEG-DOMAIN FACE DETECTION
OBJECT SEGMENTATION
HIERARCHICAL VIDEO BROWSING
MANUAL TEXT ANNOTATIONS
SCENE CLASSIFICATION
MODEL BASED CLASSIFICATION SYSTEM
DESCRIPTIONS GENERATED COLLABORATORS
MPEG-7 DESCRIPTION
MPEG-7 DESCRIPTION
MPEC-7 DESCRIPTION
MPEC-7 DESCRIPTION
MPEC-7 DESCRIPTION
MPEC-7 DESCRIPTION
MPEC-7 DESCRIPTION
MPEC-7 DESCRIPTION
INTEGRATION OF MPEG-7 DESCRIPTIONS
IMAGE/VIDEO DATABASE
IMAGE/VIDEO SEARCH ENGINE
QUERY INTERFACE AND IMAGE/VIDEO BROWSER
205
210
220
230
240
250
260
270
280
211
221
231
241
251
261
271
281
290
295
170
206
200

FIG. 8

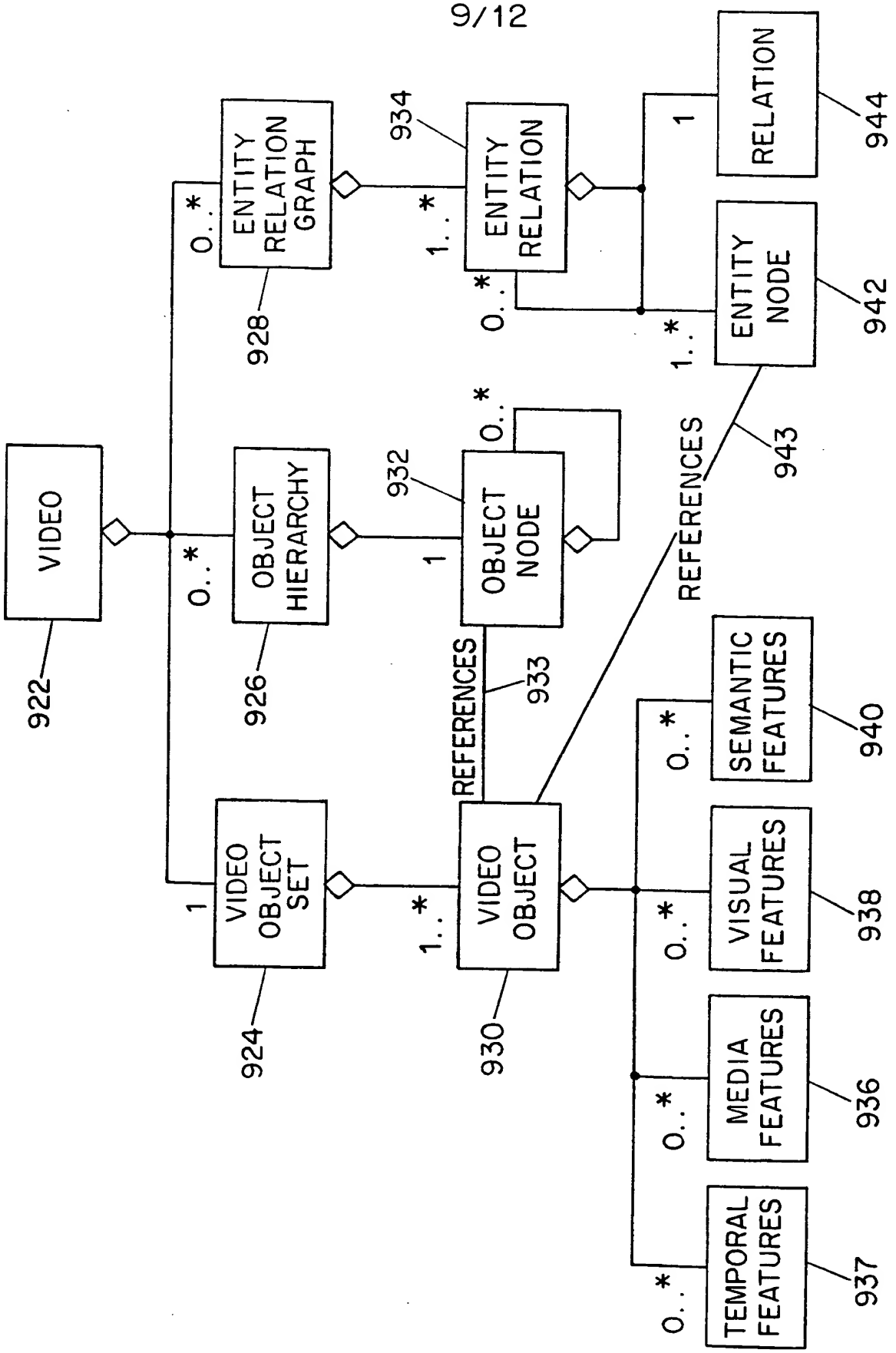
VIDEO
922
OBJECT HIERARCHY
926
ENTITY RELATION GRAPH
928
VIDEO OBJECT SET
924
OBJECT NODE
932
ENTITY RELATION
934
VIDEO OBJECT
930
REFERENCES
933
ENTITY NODE
942
REFERENCES
943
RELATION
944
SEMANTIC FEATURES
940
VISUAL FEATURES
938
MEDIA FEATURES
936
TEMPORAL FEATURES
937
0..*
1..*
1

FIG. 9

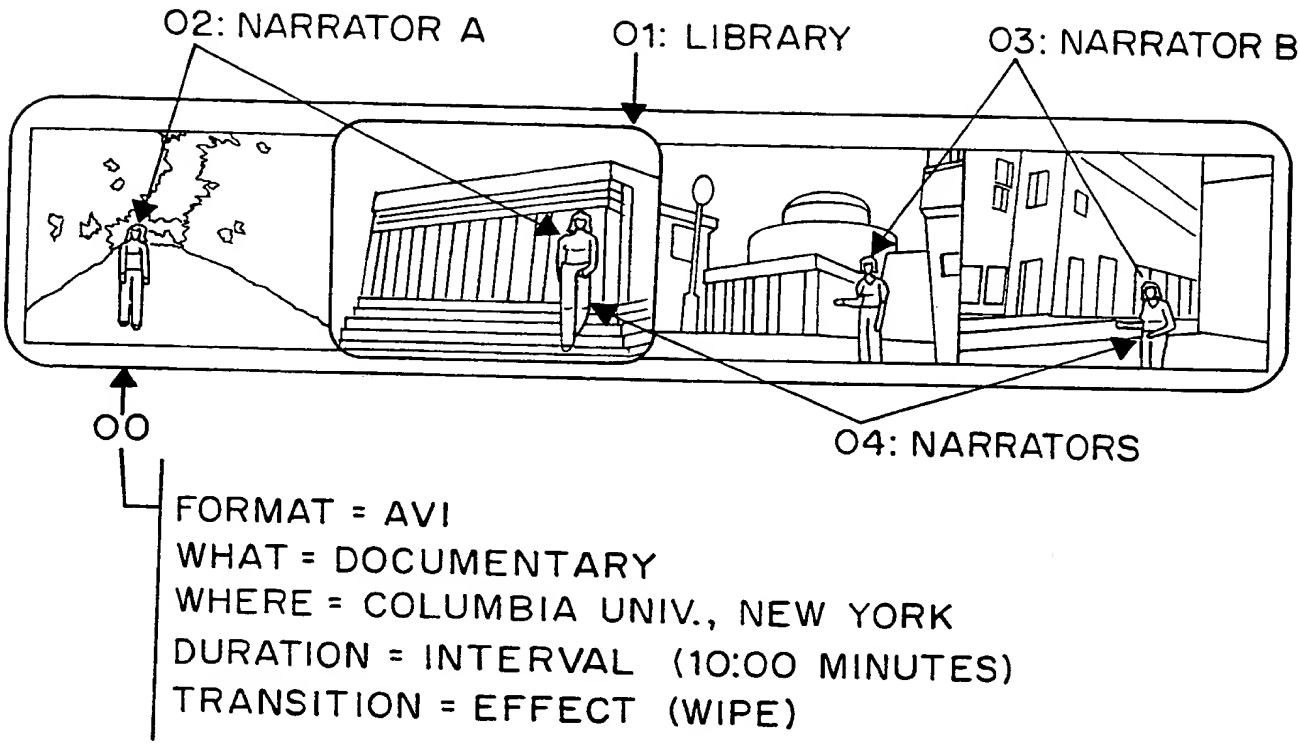

FIG. 10

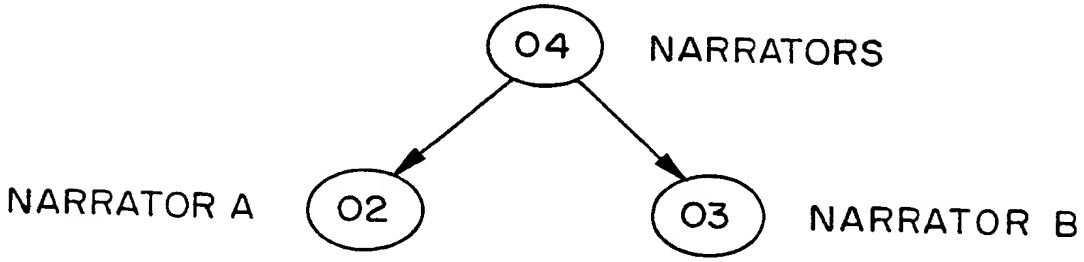

FIG. 11

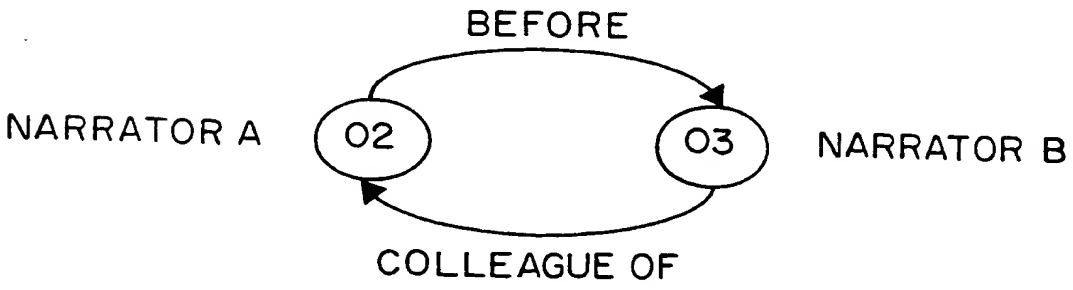

FIG. 12

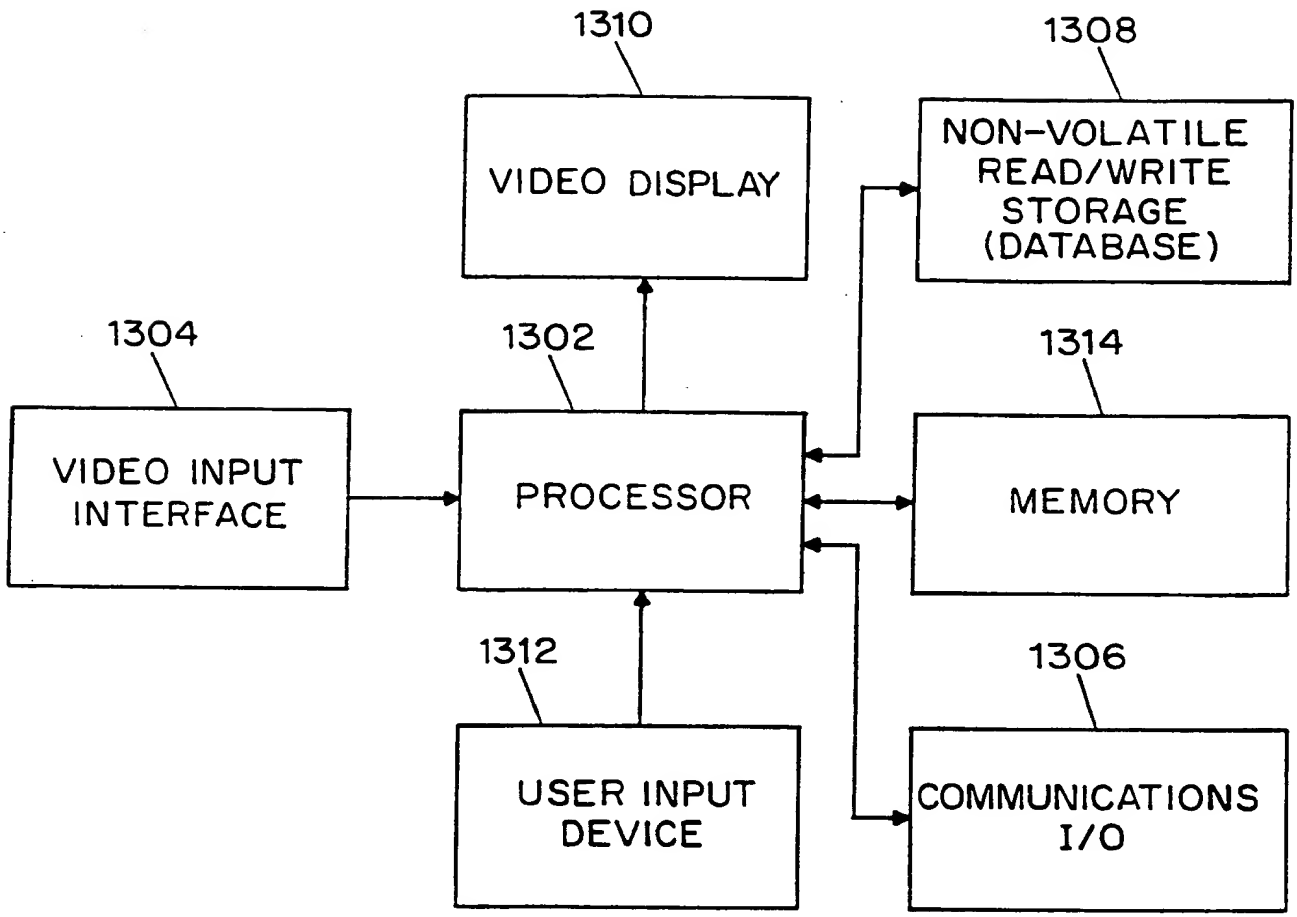
1310
VIDEO DISPLAY
1308
NON-VOLATILE READ/WRITE STORAGE (DATABASE)
1304
VIDEO INPUT INTERFACE
1302
PROCESSOR
1314
MEMORY
1312
USER INPUT DEVICE
1306
COMMUNICATIONS I/O

FIG. 13

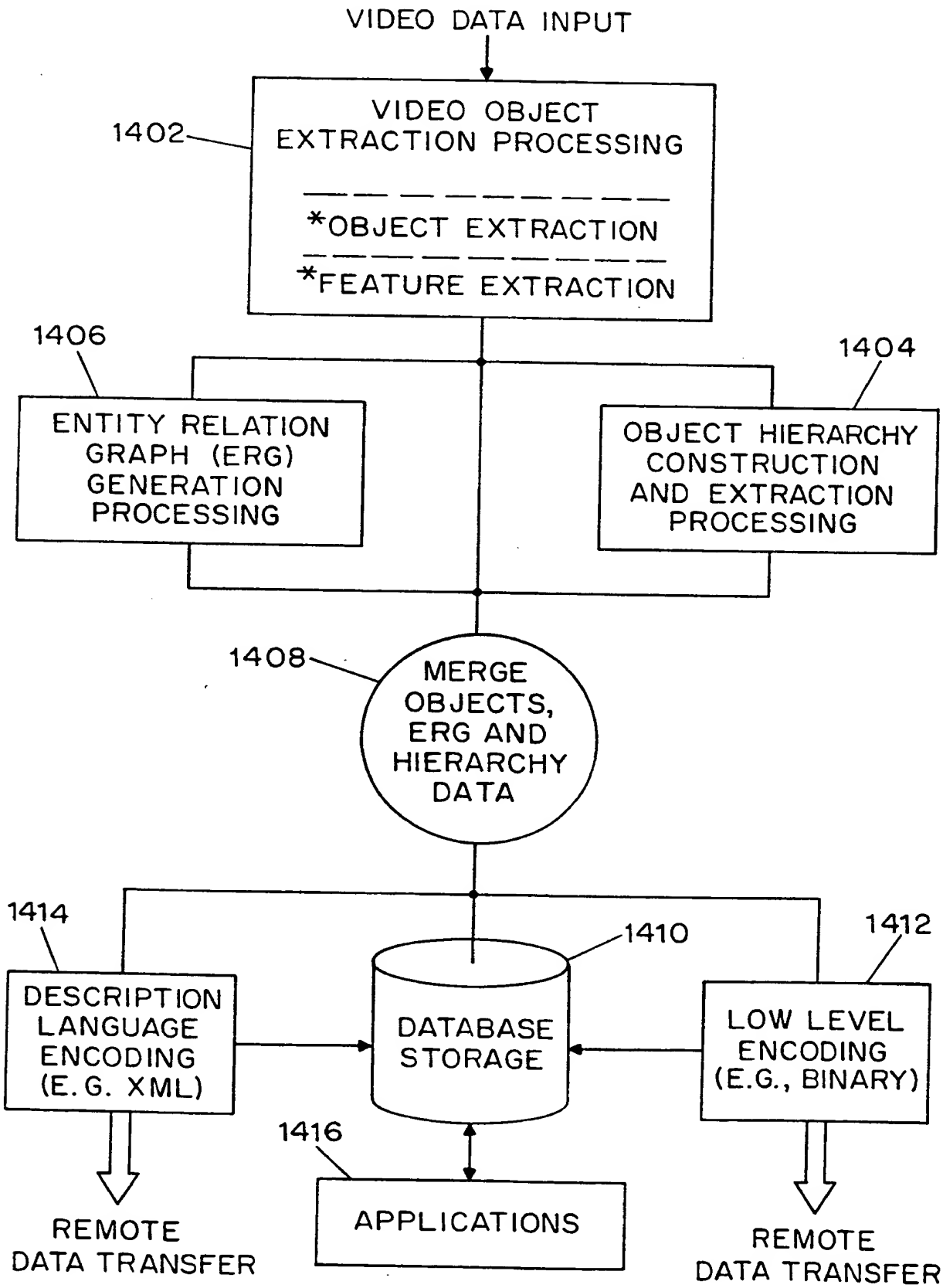
VIDEO DATA INPUT
1402
VIDEO OBJECT EXTRACTION PROCESSING
*OBJECT EXTRACTION
*FEATURE EXTRACTION
1406
ENTITY RELATION GRAPH (ERG) GENERATION PROCESSING
1404
OBJECT HIERARCHY CONSTRUCTION AND EXTRACTION PROCESSING
1408
MERGE OBJECTS, ERG AND HIERARCHY DATA
1414
DESCRIPTION LANGUAGE ENCODING (E.G. XML)
1410
DATABASE STORAGE
1412
LOW LEVEL ENCODING (E.G., BINARY)
1416
APPLICATIONS
REMOTE DATA TRANSFER
REMOTE DATA TRANSFER

FIG. 14

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60/118,027	1 February 1999 (01.02.99)	US

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(74) Agent: TANG, Henry; Baker & Botts, LLP, 30 Rockefeller Plaza, New York, NY 10112-0228 (US).

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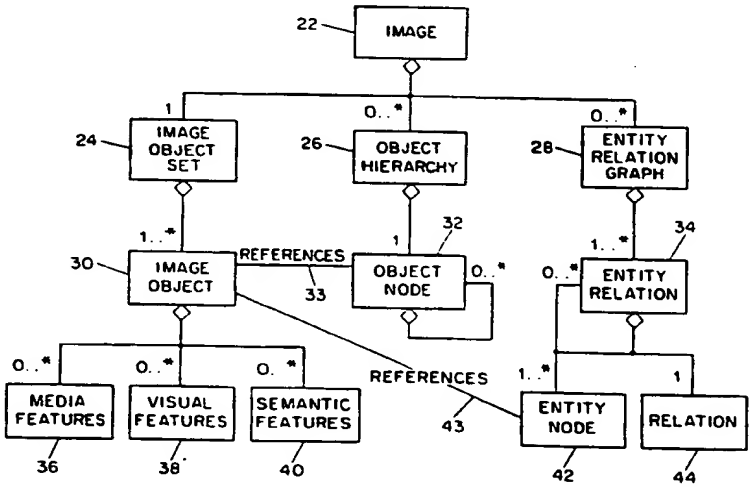

(57) Abstract

Systems and methods for describing video content establish video description records which include an object set (24), an object hierarchy (26) and entity relation graphs (28). Video objects can include global ojects, segment objects and local objects. The video objects are further defined by a number of features organized in classes, which in turn are further defined by a number of feature descriptors (36, 38 and 40). The relationships (44) between and among the objects in the object set (24) are defined by the object hierarchy (26) and entity relation graphs (28). The video description records provide a standard vehicle for describing the content and context of video information for subsequent access and processing by computer applications such as search engines, filters, and archive systems.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/26126

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06F 17/30
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 707/1, 103, 204; 345/327, 418, 430, 431, 439, 475; 348/154, 155, 429.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,821,945 A (YEO et al) 13 October 1998, col. 1, lines 31-67, col. 2, lines 1-67, col. 3, lines 1-67, col. 4, lines 1-67, col. 5, lines 1-2 and 23-67, col. 6, lines 1-67, col. 7, lines 1-67, col. 8, lines 1-67, col. 9, lines 1-67, col. 10, lines 1-67, col. 11, lines 1-6 and lines 16-40, and col. 12, lines 1-38.	1-75

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 05 APRIL 2000	Date of mailing of the international search report 10 MAY 2000
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/26126

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,555,354 A (STRASNICK et al) 10 September 1996, col. 6, lines 4-67, col. 7, lines 1-38, col. 8, lines 9-47, col. 9, lines 37-44 and lines 66-67, col. 10, lines 1-23, col. 12, lines 1-42, col. 15, lines 20-67, col. 16, lines 1-47, col. 17, lines 6-18, col. 19, lines 57-67, col. 20, lines 52-67, col. 21, lines 6-47, col. 22, lines 16-50, col. 23, lines 49-53, col. 26, lines 49-67, col. 27, lines 1-5, and lines 21-62, and col. 30, lines 37-44.	1-75
Y	US 5,742,283 A (KIM) 21 April 1998, col. 1, lines 19-67, col. 2, lines 1-67, col. 3, lines 1-12 and lines 58-65, col. 4, lines 8-67, col. 5, lines 22-67, col. 6, lines 1-41, col. 7, lines 2-56, col. 10, lines 18-67, col. 11, lines 1-22 and lines 39-67, col. 12, lines 1-67, col. 13, lines 1-67, col. 14, lines 41-63, col. 15, lines 28-67, col. 16, lines 1-67, col. 17, lines 1-9 and lines 17-45, and col. 18, lines 1-43.	1-75

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/26126

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

707/1, 103, 204; 345/327, 418, 430, 431, 439, 475; 348/154, 155, 429.

B. FIELDS SEARCHED
Electronic data bases consulted (Name of data base and where practicable terms used):

EAST, WEST
Search terms: video, multimedia, object, hierarchy, entity relation graphs, MPEG-7, MPEG-4, XML.

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(54) Title: VIDEO DESCRIPTION SYSTEM AND METHOD

(57) Abstract

Systems and methods for describing video content establish video description records which include an object set, an object hierarchy and entity relation graphs. Video objects can include global ojects, segment objects and local objects. The video objects are further defined by a number of features organized in classes, which in turn are further defined by a number of feature descriptors. The relationships between and among the objects in the object set are defined by the object hierarchy and entity relation graphs. The video description records provide a standard vehicle for describing the content and context of video information for subsequent access and processing by computer applications such as search engines, filters, and archive systems.

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